

# Compressed Air

*Magazine*

JUNE 1958



FIRE FIGHTER IN  
PORT OF NEW YORK

"William J. Gaynor" can pump  
7000 gpm at 175 psig,  
move at 14 knots

VOLUME 63 • NUMBER 6

NEW YORK • LONDON

**IN A CLASS BY ITSELF...**



# Axi-compressor

**Not Reciprocating...**

**Not Centrifugal...**

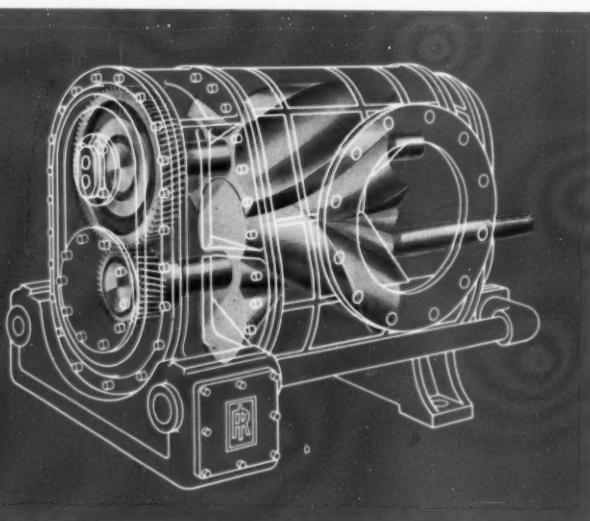
**It's an**

## **AXIAL FLOW ROTARY COMPRESSOR**

Capacity 100-12,000 cfm

Pressures to 15 psig

Vacuums to 15" Hg.



### **HERE'S HOW IT WORKS...**

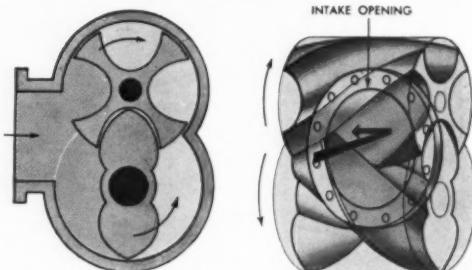
**B**ECAUSE of its unique rotary design, the Ingersoll-Rand Axi-compressor delivers air or gas with less power in a smaller space than other types of compressor of equivalent capacity. It is equally suitable for pressure, vacuum or combination operation.

Utilizing the axial flow, positive displacement principle, the Axi-compressor discharges air smoothly and continuously, free from shocks. There are no pistons or valves, and the only moving parts are two perfectly balanced helical rotors which operate with minimum noise or vibration. The rotors never touch each other or the casing. Hence there's no need for internal lubrication.

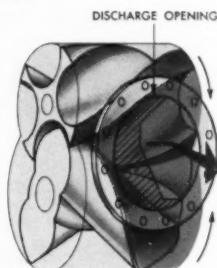
#### **Advantages:**

- **Space-Saving, Compact Design** — can be installed on simple, low-cost foundations.
- **Clean, Oil-Free Air** — no danger of contamination from lubricants.
- **Smooth, Pulsation-Free Compression** — no bulky air receivers required.
- **Operates at Higher Motor Speeds** — can be direct driven without belts or gears.

Ask your Ingersoll-Rand representative for complete information. Or send today for a copy of Bulletin 11,001A.



**Intake:** During the inlet cycle rotors are turning away from each other, drawing air or gas into the inlet space. This gas is then moved around to the discharge side of the compressor.

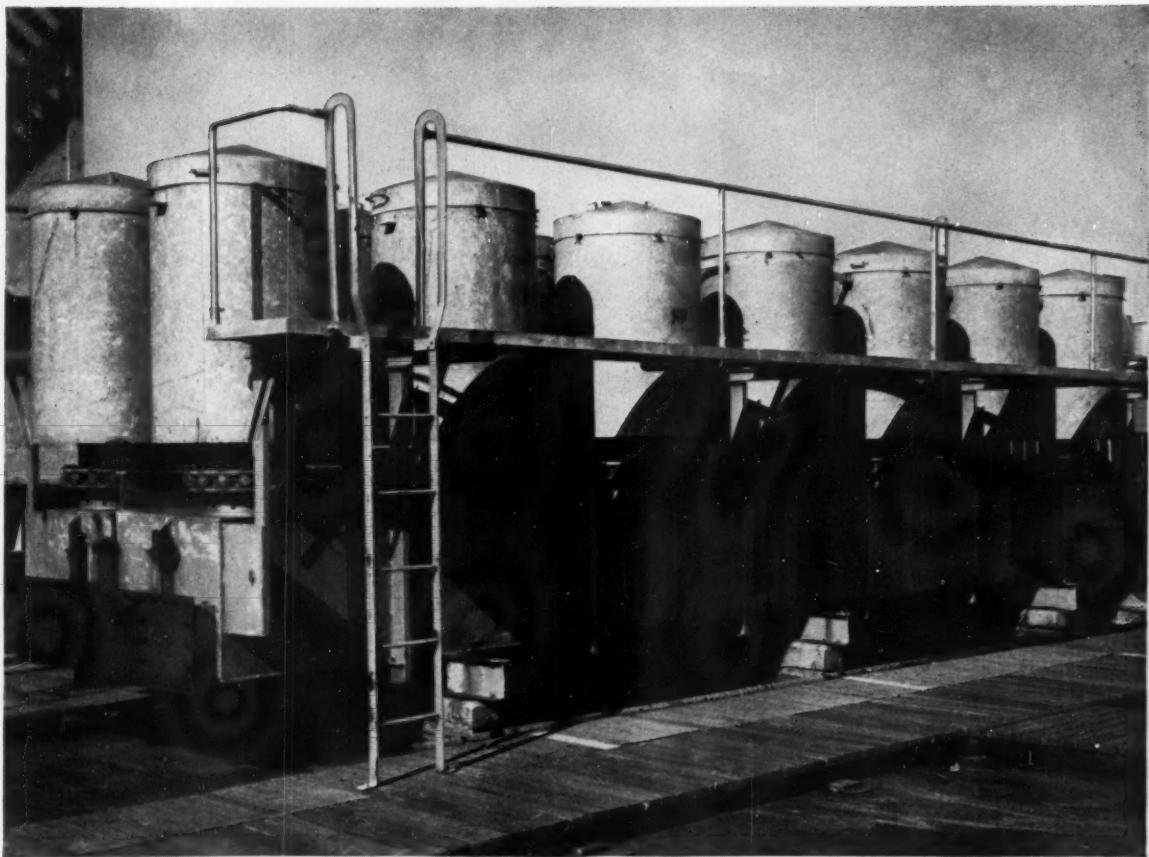


**Compression and Discharge:** During the discharge cycle the rotors are turning toward each other. They displace the inlet volume and air is smoothly compressed and forced axially toward the discharge opening.

**Ingersoll-Rand**

17-847

11 Broadway, New York 4, N. Y.



Staynew air-intake filters control intake-processing air at E. R. Squibb Division of Olin Mathieson Chemical Corporation.

## Over 10-Year Period . . .

### Squibb Finds Staynew Filters Economical, Reliable

Eighteen Staynew Air-Intake Filters, equipped with maximum silencer tubes, filter a total intake capacity of approximately 60,000 cfm at E. R. Squibb Division of Olin Mathieson Chemical Corporation, New Brunswick, N. J.

Air taken in through the filters supplies four low-pressure, centrifugal compressors. Because residences and other Squibb buildings surrounded the installation, quiet intake of air was demanded.

Squibb also specified the filters must be simple and inexpensive, easily maintained, and capable of delivering clean, dry air at absolute minimum pressure drop.

Further, they must handle large quantities of air for the small area occupied, and must be flexibly arranged for partial use during servicing.

This installation has been in operation 10 years. Over that

period it has been found economical and reliable, controlling intake-processing air to a degree exceeding Squibb's exacting requirements.

The efficiency of Staynew Filters actually increases with use. Let a Dollinger Representative show you with facts and figures how to save time and money with Staynew Intake Filters.

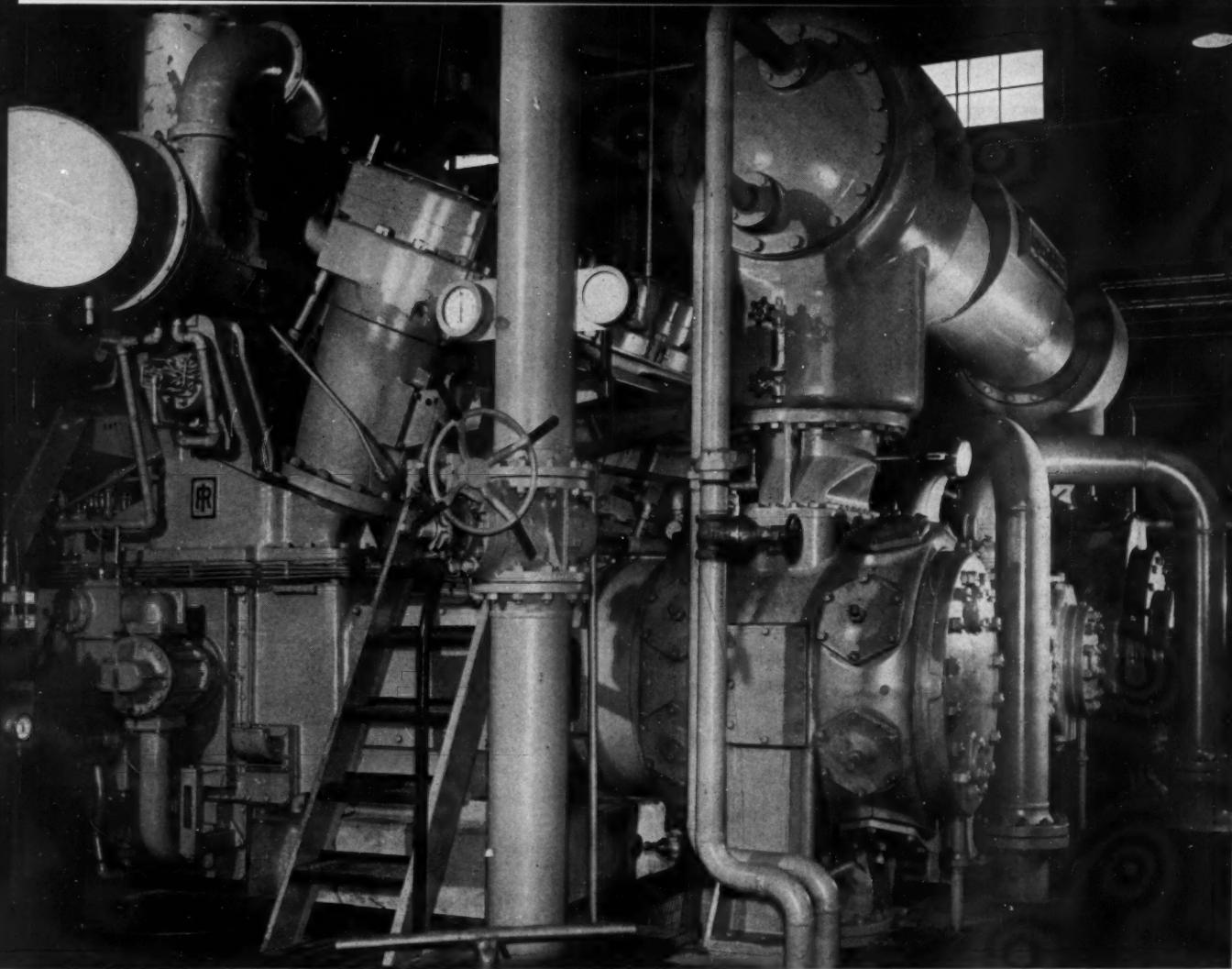
Write Dollinger Corporation,  
7 Centre Park, Rochester 3, N.Y.



**DOLLINGER**

SPECIALIZING IN DRY TYPE FILTERS FOR OVER 35 YEARS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOSITY PANEL FILTERS • LOW PRESSURE FILTERS  
HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS



## FORTIFIED TEXACO REGAL OIL R&O cuts compressor maintenance costs

In Texaco Regal Oils R&O you get a lubricant that makes air compressors run longer and better with less maintenance—because Texaco Regal Oils R&O are refined with special care from selected base stocks, and then *fortified* with rust and oxidation inhibitors.

The fine lubricating qualities of Texaco Regal Oil R&O minimize wear in air compressors. The rust inhibitors in Texaco Regal Oil R&O keep cylinders, intercoolers and aftercoolers in "like new" condition. And the oxidation inhibitors in Texaco Regal Oil R&O prevent the formation of sludge, keep valves, pistons and discharge passages free of harmful deposits.

There is a complete line of Texaco Regal Oils R&O to meet the requirements of compressors under all oper-

ating conditions. A Texaco Lubrication Engineer will gladly help you select the correct one.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.



**LUBRICATION IS A MAJOR FACTOR IN COST CONTROL**

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

# Compressed Air Magazine

Founded 1896

R. J. Nemmers, *Editor*  
S. M. Parkhill, *Assistant Editor*  
C. H. Vivian, *Contributing Editor*  
D. Y. Marshall, *Europe*,  
243 Upper Thames St., London, E.C. 4.  
F. A. McLean, *Canada*,  
New Birks Building, Montreal, Quebec

VOLUME 63 NUMBER 6

June 1958

## FEATURE ARTICLES

### Page 14 Driving A 560-Foot-Long Aperture—*S. M. Parkhill*

Flowing out of the Appalachian Plateau in northeastern Pennsylvania, the Lackawaxen River and its three principal tributaries have repeatedly flooded nearby communities. To control the streams, a 3-part program has been inaugurated. One of two dams included in it, Dyberry Dam, will normally be dry. In flood stage, however, it will retain waters that cannot pass through an 8-foot-diameter aperture, the driving of which is described in this article.

### 20 The Refining Of Corn, Part II—*R. J. Nemmers*

This second part of the story of corn products deals with the operations of Clinton Corn Processing Company. The refining of corn starch is similar in many ways to that of petroleum refining. Carbohydrates, according to chemists, are composed of the same essential building blocks as are hydrocarbons. In corn refining, the blocks are sometimes rearranged or altered, thereby producing products more suitable for man's use than the raw material.

### 26 Redesigned Valve For Atlas

One of the toughest jobs in fluids handling is the proper design of a means of blocking its flow when desired—in other words, a valve. The difficulties have been compounded in missiles programs because of weight restrictions, temperature differentials, etc. The solution to one problem is described here.

### 29 Glideair

Compressed air has been utilized in many ways, but Ford Motor Company has come up with an idea that may make it possible for the versatile power to replace wheels. The firm has designed a vehicle supported on a thin layer of high-velocity compressed air—a vehicle that can be moved along encountering little friction other than that of the atmosphere itself.

## DEPARTMENTS

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G. W. Morrison, *Publisher*

R. W. Sapora, *Manager*



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11 Broadway, New York 4, N. Y.



Putting down hole with Bethlehem Hollow at sandstone property of Sullivan Highway Products Corp., Kenoza Lake, N. Y. Drill steel reconditioner: Howells Mining Drill Corp., Plymouth, Pa.

## Daily production: 1200 tons of crushed stone

Here you see Bethlehem Hollow Drill Steel, 1½ in. round, biting into medium-hard, abrasive sandstone in the quarry of Sullivan Highway Products Corp., Kenoza Lake, N. Y. The 2½ in. blast holes, on 6-ft centers, average 24 ft in depth. Quarried at the rate of 1200 tons daily, the Specification Crushed Stone is for general highway use.

Bethlehem Hollow Drill Steel is just the ticket for rock drillers because it is rolled from fatigue-resistant steel, and has a uniform hole which is centrally located in the bar. The steel has a wide quenching range, and is easy to heat-treat

for the proper balance of toughness and wear-resistance, making possible long-wearing threads and strong shanks.

Bethlehem Hollow is made in Carbon and Ultra-Alloy grades in rounds, hexagons, and quarter octagons. It is furnished in lengths of from 18 ft to 27 ft. Longer lengths can also be supplied to meet special needs. Put it to work on your next rock drilling project.

**BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.**  
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation.

## BETHLEHEM HOLLOW DRILL STEEL

CARBON AND  
ULTRA-ALLOY



GRACE CHEMICAL CO., DIVISION OF W. R. GRACE & CO.

## LEADERS IN INDUSTRIAL SAFETY:



At its Memphis plant, Grace Chemical produces 300 tons of anhydrous ammonia per day. Three 4,000-h.p. compressors are the heart of this operation, each handling 3 different gases under varying intake and discharge conditions.

## Fire-resistant PYDRAUL AC protects huge compressor operations at Grace Chemical Co.

Turning out 300 tons of anhydrous ammonia per day depends on reliable and SAFE performance of the compressors. That's why Grace engineers at Memphis take every precaution to insure continuous operation. They choose fire-resistant Pydraul AC to lubricate air compressors, minimize carbon deposits and thus reduce fire dangers.

Compressor fire and explosion dangers lurk in flammable lubricants and their

residues deposited in compressed air cylinders and piping. Eliminate these dangers now in your compressors, any size, any make.

Conversion is easy . . . essentially, just drain your flammable fluid and replace with fire-resistant Pydraul AC. Send the coupon for your copy of the new Pydraul AC booklet . . . for the answers to your compressor lubricant problems.

Organic Chemicals Division

**MONSANTO  
CHEMICAL COMPANY**

Dept. CA-1

St. Louis 24, Missouri

Pydraul: Reg. U.S. Trademark



WHERE CREATIVE CHEMISTRY  
WORKS WONDERS FOR YOU

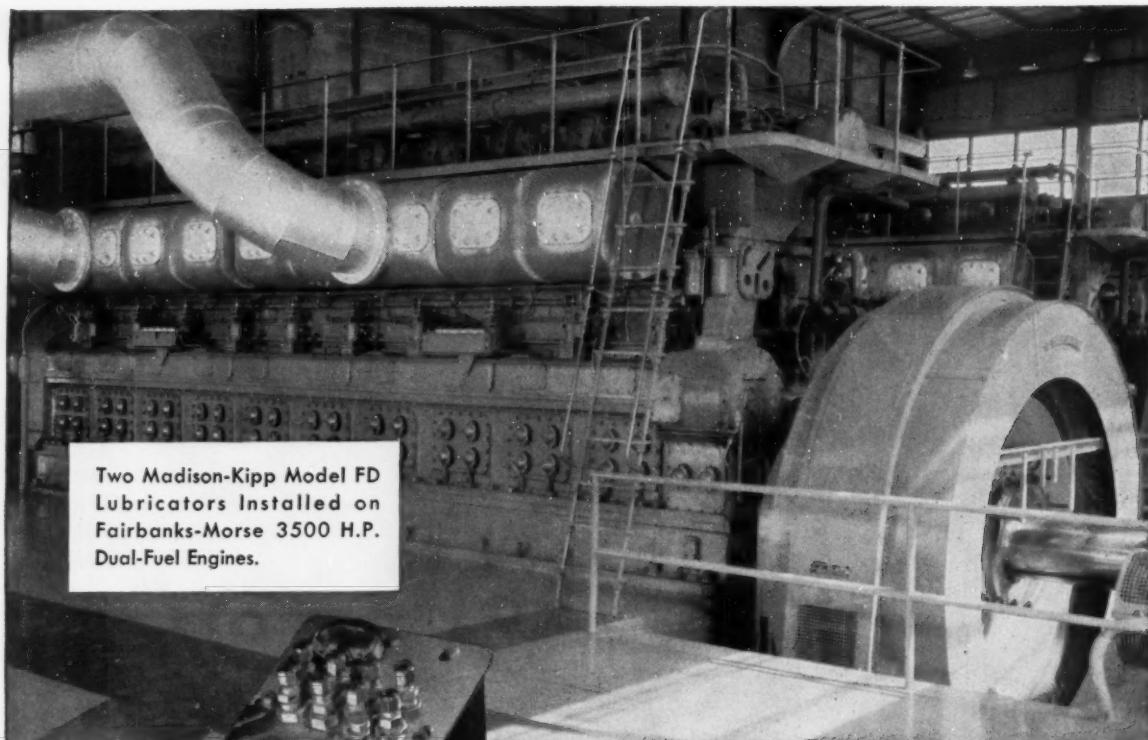
Please  
send me  
the  
**PYDRAUL AC**  
booklet

Name..... Title.....

Firm.....

Address.....

City..... State.....



Two Madison-Kipp Model FD  
Lubricators Installed on  
Fairbanks-Morse 3500 H.P.  
Dual-Fuel Engines.

**Machines of great performance  
use the most dependable  
oiling system ever developed**

**MADISON-KIPP**

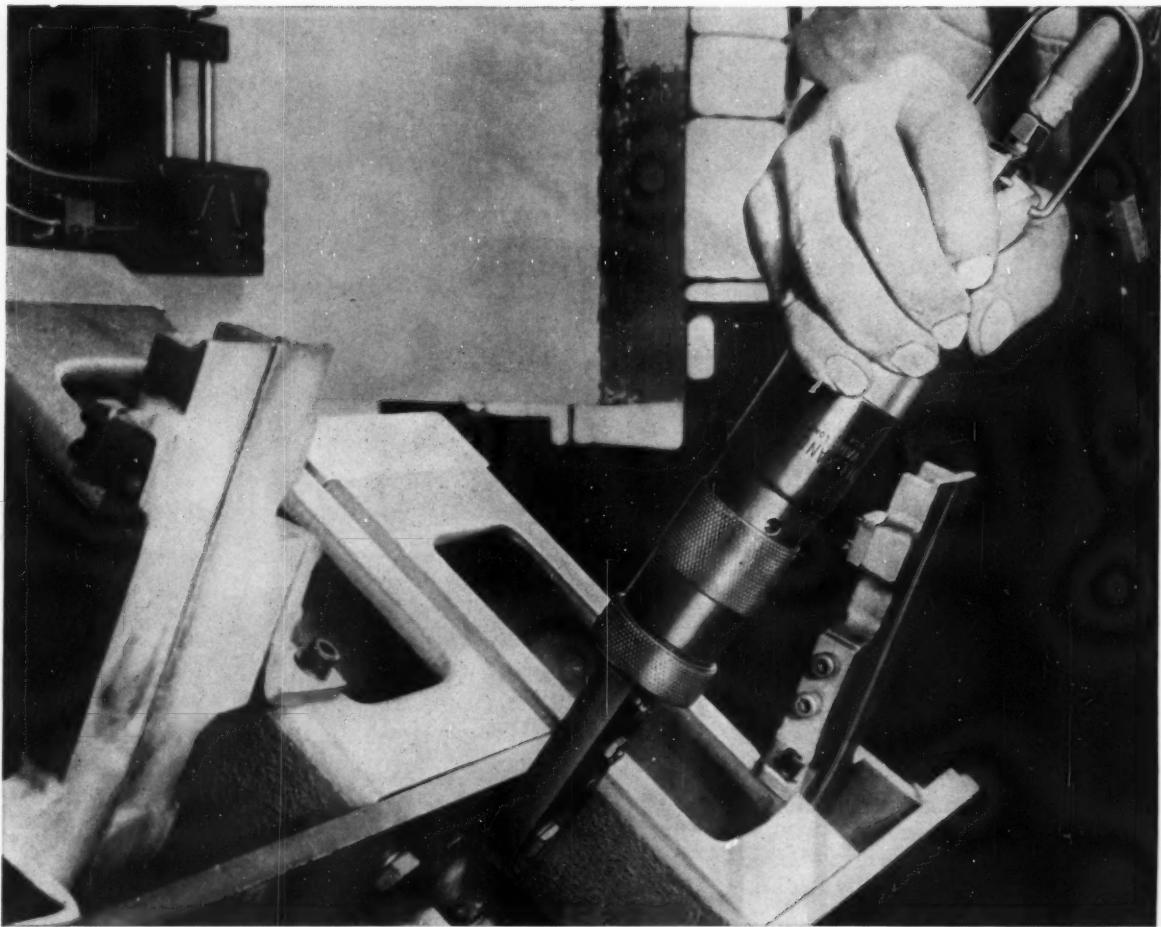
*Fresh Oil*

...by the measured drop, from a Madison-Kipp Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's finest machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy, where oil under pressure fed drop by drop can be installed. There are 6 models to meet almost every installation requirement.



**MADISON-KIPP CORPORATION**  
202 WAUBESA STREET • MADISON 10, WIS., U.S.A.

Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools



**Built to take punishment**—001JW Ratchet Wrench shown running car screws on automatic assem-

bly machine. Nickel alloy steel parts minimize maintenance and help keep tool working longer.

## How Nickel Alloy Steels help tools like this keep on working for you!

Look carefully at this new pneumatic ratchet wrench made by Ingersoll-Rand. Notice its compactness . . . its short overall length . . . its narrow width . . . its thin  $\frac{1}{2}$ -inch ratchet head.

These features permit the tool to operate easily, efficiently in tight spots.

Critical parts must be thin yet have excellent toughness and strength to give many years of dependable service. They are made of two nickel alloy steels: type 8640 and 8620.

These steels, with .55% Nickel, give the rotor, gear case, connecting rod and other key parts the extra strength, toughness and wear resis-

tance needed for continuous operation under high stress and shock loads.

There is a variety of nickel alloy steels. Each one a specific for handling special problems of heat, corrosion, wear, strength, or a combination of these factors.

Whether you manufacture or use equipment, Inco's Development and Research Division can help you on material problems. They will be glad to send pertinent information on specific metal problems. Just write for the facts you want.

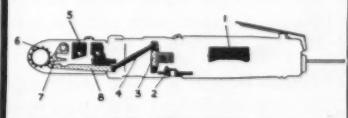
\*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.  
67 Wall Street  New York 5, N.Y.

### NOTE TO DESIGNERS:

Here's where nickel-containing alloy steels are used in I-R's new pneumatic ratchet wrench:

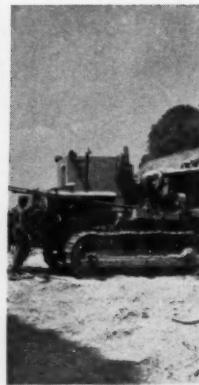
- |                     |                        |
|---------------------|------------------------|
| (1) rotor           | (5) side plate support |
| (2) gear case       | (6) socket             |
| (3) push rod driver | (7) socket pawl        |
| (4) connecting rod  | (8) push rod           |



**INCO NICKEL**  
**NICKEL ALLOYS PERFORM BETTER LONGER**



HYDRA-  
BOOM  
DRILLS

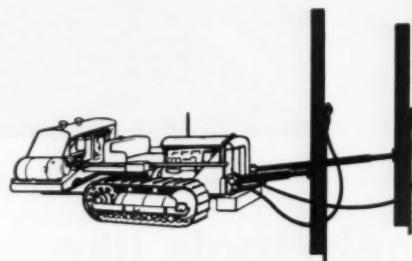


TRACTOR  
OR  
TRUCK



GYRO-FLO  
COMPRESSOR

*put them together  
and you have  
a time-saving  
labor-saving*



## Hydra-Boom DRILLING RIG

Here's a rugged, self-powered and self-propelled drilling rig that will increase production, cut drilling costs and convert setup time into *drilling time* on any rock excavation job.

With two I-R Hydra-Boom mounted X71-WD Drifters, you can spot holes on a dime and set up to drill in *any position* at the touch of a throttle. Hydra-Booms lift, tilt, extend, retract, dump and swing by smooth, hydraulic power. Operators spend time *drilling rock* — not lugging heavy equipment over rough ground. On job after job, Hydra-Boom Drilling Rigs have doubled production per shift and cut total cost per foot of hole by 50% or more.

Hydra-Booms are big and rugged, with larger, more powerful cylinders that work at lower pressure, hold better, eliminate creeping and require less maintenance. Safety-lock check valves prevent booms from creeping or dropping.

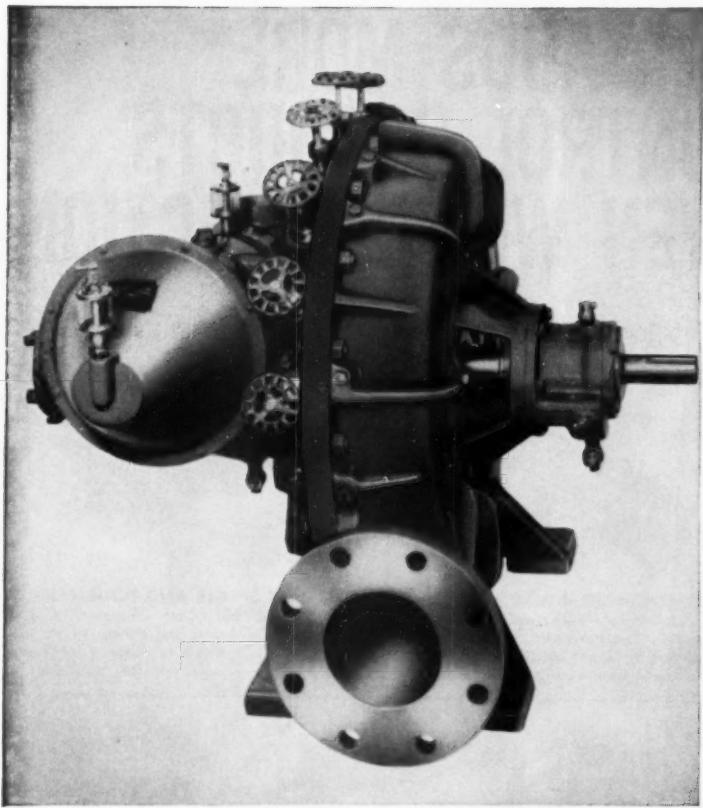
The 600 cfm Gyro-Flo rotary compressor provides ample air power to run both drills simultaneously at top efficiency. And because it has no pistons, rings, valves, rods or clutch, it requires far less attention and maintenance than other types of portable compressors. With the air power plant right on the same rig, hose connections are short and always out of the way, eliminating air hose breaks due to freezing, blasting or collisions.

For the complete Hydra-Boom story, see your nearest I-R representative, or write to Ingersoll-Rand for a copy of new Bulletin No. 4196.

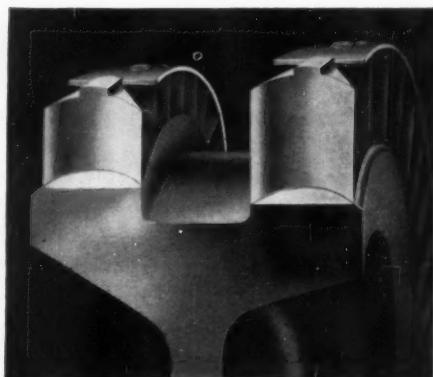


**Ingersoll-Rand**  
5-846      11 Broadway, New York 4, N.Y.

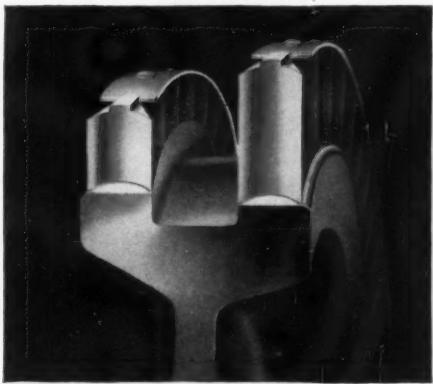
A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK



*This is the reliable Coppus Turbine furnished with either type of wheel*



*Wide bucket "L" type wheel*



*Regular type wheel*

## *Top performance in all COPPUS TURBINES*

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that

a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed

safety trip supplementing constant speed governor.

- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands. Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION  
206 Park Avenue, Worcester 2, Mass.  
Sales offices in THOMAS' REGISTER



# SCHRADER ADDS MORE NEW AIR CONTROL PRODUCTS TO GIVE YOU EVEN WIDER SELECTION

**NEW!**



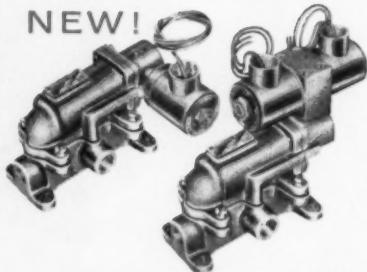
**HOSE REEL FOR AIR TOOL SUSPENSION**  
—Saves duplicate equipment and maintenance. Saves time on high speed production. Spring tension counterbalances air tools. Powerful spring automatically takes up tool.

**NEW!**



**DOUBLE SOLENOID 4-WAY VALVES** —  
Now double solenoid 4-way action available in full series . . . voltage-wise, port size, flow capacity. Permits longer dwell time in either position without continuous electrical energy.

**NEW!**



**SUB-BASE SINGLE AND DOUBLE SOLENOID VALVES** — Greater versatility. You don't have to disturb the piping for service. Reduces "down time" to absolute minimum. Complete series: voltages, sizes, capacities.

**NEW!**



**PILOT OPERATED SUB-BASE 4-WAY VALVES** — Sturdy cast meehanite sub-base contains all ports for piping air. Permits removal of valve mechanism for service without disturbing piping. Complete new series!

**NEW!**



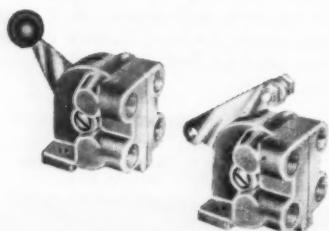
**NEW! 3-WAY SOLENOID VALVES** — Simple 3-way action available in full series—voltage, port sizes, flow capacities. By shifting pilot chamber head 90°, normally open changes to normally closed, and vice versa!

**NEW!**



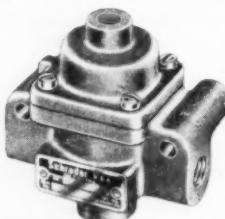
**2- AND 3-WAY FOOT VALVES** — With right angle ports. Give convenience and control with simplest installation. Mount directly on floor.  $\frac{3}{8}$ " N.P.T. Sturdy, compact, and versatile. Take minimum space.

**NEW!**



**SLIDING SEAL VALVES FOR PIPED EXHAUST** — Complete series! 2, 3, 4-way types.  $\frac{1}{4}$ " N.P.T. ports. Hand or mechanical lever. Compact, minimum working parts.

**NEW!**



**3-WAY PILOT VALVES** — Complete new line. Normally open or normally closed types. Ideal for single-acting cylinders. Simple, neat, sturdy. May easily be converted to solenoid.

**NEW!**



**CHECK VALVES** — Thread combinations now in complete series in spring-loaded check type. Pinpoint your needs. Amazingly compact, relative to large flow capacity. Capacity 35 cu. ft.

Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

A. SCHRADER'S SON • Division of Scovill Manufacturing Company, Incorporated  
478 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR PRODUCTS

**Schrader®**  
a division of **SCOVILL**

A businessman asks: "Could I spell out my plan?"

Naturally, his insurance agent answers in the affirmative.

A government defense panel worries: "If we're ~~unprepared~~ to fire, what could happen with incendiary bombs?" Is this ~~untrue~~?

That's the way it went all over the country this year. Report after report that fire losses increased during the first quarter of 1961. And everybody had his ideas on how to prevent fires. Some were good, some were not. One idea, however, was accepted by almost everyone:

- \* Fire-resistant hydraulic fluids
- \* And cellulube synthetic lubricants.

## Fire Losses Hit \$315.4 Million

Tell for the first quarter of 1961, fire losses are up 16.7% over a year ago.

ties, papers and petro-

chemicals

## Plan against it . . . not for it!

*Cellulube fire-resistant hydraulic fluids and synthetic lubricants open up new areas of in-plant fire prevention*

The stakes are high—personnel, equipment, production, reputation. No one has better reasons than industry has to plan against fire.

And with today's advances in chemistry, industry has never had more effective and specialized materials with which to do just that.

Cellulube fire-resistant hydraulic fluids and synthetic lubricants are good examples. In hydraulic equipment, they reduce the danger

of uncontrollable fire caused by line breaks or other failures when flammable fluids are in use. In air compressors, these non-petroleum oils not only prevent excessive carbon formations—the main source of fire and violent explosion—but also meet the severest of lubrication requirements.

Minimizing the hazards of industrial operations through development of fire-resistant

Cellulubes . . . making these functional fluids available in 6 controlled viscosities for broader application . . . this is another example of Celanese research and product development at work hand-in-hand with industry.

Celanese Corporation of America, Chemical Division, Dept. 596-F, 180 Madison Avenue, New York 16.

Celanese® Cellulube®

### Basic reasons . . . . .

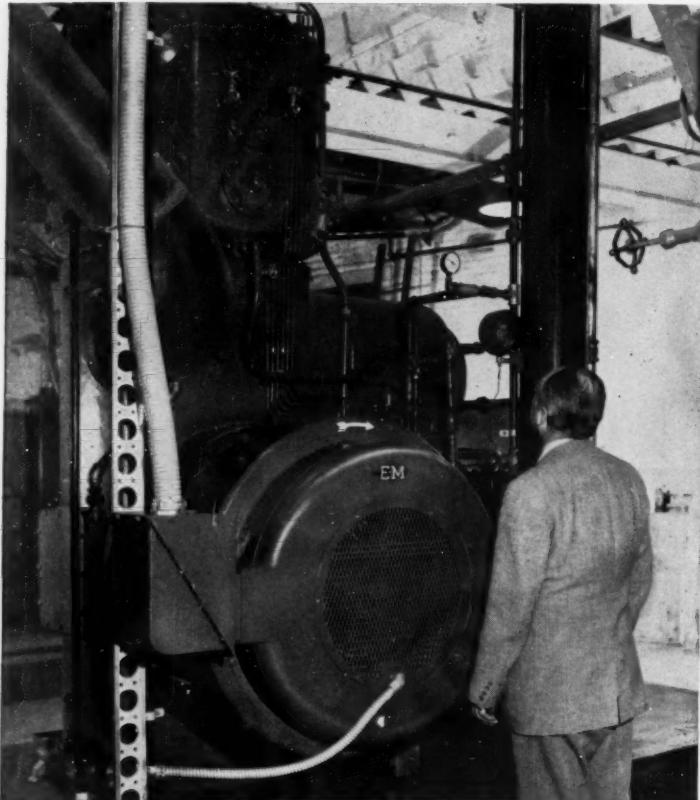
Acids	Functional Fluids	Polyols
Alcohols	Gasoline Additives	Plasticizers
Aldehydes	Glycols	Salts
Anhydrides	Ketones	Solvents
Esters	Oxides	Vinyl Monomers

### . . . . . for improved products



Agricultural	Paper
Automotive	Pharmaceutical
Aviation	Plastics
Building	Surface Coatings
Electrical	Textiles

# What control would you specify for a flange-mounted synchronous motor air compressor drive?



Paktrol efficiently controls this E-M 200 hp, 514 rpm, 1.0 PF, 440-volt Flange-Mounted Synchronous Motor at The Eberhard Company.

## Features and Advantages of NEW PAKTROL CONTROL

**1 Lower Cost** — Wherever Paktrol can be used costs are saved two ways. Its built-in selenium rectifier lowers both initial and installation costs as compared to those of a separate synchronous motor control and motor-generator set.

**2 Simple Operation** — Start-stop pushbutton magnetic full-voltage operation with "conscious" control by the E-M developed Polarized Field Frequency Relay system.

**3 Full Protection for Motor and Control** — Relays protect against overloads, overcurrents, abnormally low line voltage, single-phase operation, or out-of-step operation. Fuses protect rectifier and transformer.

**4 Minimum Maintenance** — Static rectifier for d-c field excitation eliminates maintenance of brushes, commutator, and bearings of conventional rotating exciter.

Paktrol is available for use with unity power factor flange-mounted synchronous motors driving air compressors in ratings of approximately 75 thru 200 hp in applicable speeds of 720, 600, or 514 rpm.

Let your nearest E-M sales engineer show you how to get the best performance from your air compressor flange-mounted synchronous motor drive. Write the factory for E-M Paktrol Control Bulletin No. 220.



3100-TPA-2184

ELECTRIC MACHINERY MFG. COMPANY  
MINNEAPOLIS 13, MINNESOTA

**Specialists in making motors do EXACTLY WHAT YOU WANT THEM TO**

Here's why Eberhard chose  
the NEW **E-M**  
**PAKTROL CONTROL**

The Eberhard Company of Cleveland, Ohio, a division of Eastern Malleable Iron Company, selected an E-M Flange-Mounted Unity Power Factor Synchronous Motor to drive an air compressor in their plant. The compressor is unloaded at start and operates at standard load and speed.

Such characteristics meant that a simplified control could be used. A control having meters, field rheostat and a separate motor-generator set for field excitation was unnecessary.

Careful comparison by Eberhard of the new simplified E-M Paktrol Control with other type controls resulted in it being chosen for the features given below.





The Eimco 630 Excavator . . . High Capacity Loading, rugged construction and low maintenance costs.

## "YOU CAN'T BEAT AN EIMCO"

This phrase, coined by thousands of Eimco users since Eimco introduced successful overhead loading 26 years ago, and used in mines throughout the world has been earned through an unexcelled, honest and dependable performance by machines always assigned to the task of hard severe service.

Robust, gadget-free, hell-for-stout construction that is typical of all Eimco Loaders is also found in the 630, pioneered by Eimco for every phase of trackless underground work.

Today the results speak for themselves. Hundreds of repeat orders from customers who have learned through their own experience — that the statement "You can't beat an Eimco" is a true fact.

An Eimco 630, similar to the machine pictured above, has loaded more than 375,000 tons at a verified average cost for maintenance of only 2.9 cents per ton loaded.

Yes! This is the type of heavy-duty equipment you get from Eimco — this is the equipment to buy to meet low metal prices and show a profit.

### THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N.Y.  
Cleveland, Ohio

Chicago, Ill.  
London, England

San Francisco, Calif.  
Gateshead, England

El Paso, Tex.  
Paris, France

Birmingham, Ala.  
Milan, Italy

Duluth, Minn.  
Pittsburgh, Pa.

Seattle, Wash.  
Johannesburg, South Africa

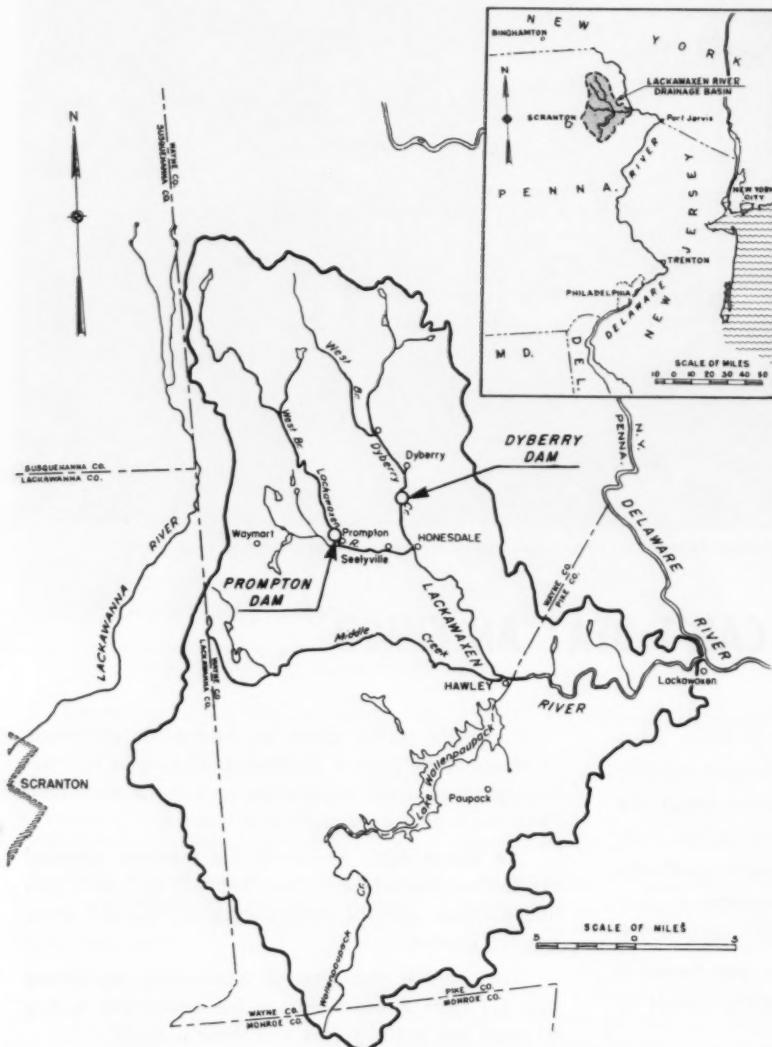


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# DRIVING A 560-FOOT-LONG APERTURE

Dyberry Tunnel Is One Phase Of The  
Lackawaxen Flood Control Project

S. M. Parkhill



## THE SITE FROM TWO PERSPECTIVES

Above are two sketch maps showing the location of the Lackawaxen River Flood Control Project. The insert shows the relative position of the basin, and the larger illustrates some of the principal towns, rivers and creeks. Above and on the opposite page, is an aerial view of the Dyberry diversion tunnel site. In the upper left of the photograph are the contractor's equipment buildings and change shacks. Further downstream (lower left), are the offices of the contractor and of the Corps of Engineers. Across Dyberry Creek, on the slope at the right of the illustration, can be seen the preliminary workings on the outlet end of Dyberry tunnel. If a photograph were taken in July from the same position, Dyberry Creek would be flowing through the aperture and would appear on the right side of the picture.



**S**OON the water from Dyberry Creek will begin flowing through a diversion tunnel in northeastern Pennsylvania. At the same time, residents in the area known as the Lackawaxen Basin, will begin to settle back in the confidence that common, springtime flooding will soon be history.

Dyberry tunnel is a vital portion of a 3-part program, inaugurated by the U. S. Army Corps of Engineers after a series of area studies in the 1940's, to prevent flash flooding of the Lackawaxen River and its principal tributaries—Dyberry, Middle and Wallenpaupack creeks. Under the sponsorship of a civilian committee headed by Dr. K. A. Gillespie and Arthur J. Wall, groundbreaking ceremonies were held on May 8, 1957.

Lackawaxen Basin is of triangular shape and includes 588 square miles of the northern portion of the Appalachian Plateau. Its longest side, the western, stretches about 41 miles along a north-south mountain range that divides the Delaware and Susquehanna river systems. The shortest boundary, of about



4 miles, is at the confluence of the Lackawaxen and Delaware rivers. (See accompanying map sketch.)

In general, the basin is characterized by steep-sloped hills varying in height from 1200 feet, near the mouth of the Lackawaxen River, to 1800-2200 feet along the watershed limits. Natural dams were left across preglacial valleys as ice retreated during the Pleistocene Epoch. Drainage was thus obstructed, and many lakes were produced. Some of these have been filled by silt, until today, they appear as nothing more than marshy patches. Waters, flowing generally southward through the area after the glacial withdrawal, carved steep-sided valleys throughout the basin. Thus, the area is marked by torrential water courses and catchment areas—two of the major factors contributing to flash flooding.

The Lackawaxen River rises in northwestern Wayne County, and flows some 23 miles southeast to Honesdale, where it is joined by Dyberry Creek. It continues another 10 miles, in relatively the same direction, to Hawley, whereupon

it turns eastward and proceeds 16 miles through narrow, steep-sided valleys, broken occasionally by  $\frac{1}{4}$ -mile-wide flood plains, to empty into the Delaware River. Over its 49-mile course, it has a total fall of 1350 feet from an initial elevation of 2000 feet above sea level. The greatest change in elevation is a drop of 58 feet per mile in the river's first 12-mile section. Some of the tributaries that drain the eastern slopes of the western watershed limit fall 500 feet and more in their first miles.

Middle Creek drains an 84-square-mile area in the midwestern portion of the basin. Its main stem rises on the 2000-foot-above-sea-level eastern slope of the western watershed, and empties into the Lackawaxen River at Hawley. Over its 18-mile course, it descends 1120 feet, the last 2 miles falling 120 feet as the creek passes through a valley, the hill slopes of which rise abruptly from the stream bed. It is one of the principal contributors to the flash flooding of the Lackawaxen.

Wallenpaupack Creek, on the other hand, is relatively under control, al-

though it drains 227 square miles—the greatest portion of the basin. Its drainage area is full of natural storage lakes and marshes. In addition, a dam was built by the Pennsylvania Power & Light Company in 1924 about 1 mile from the stream's mouth. At maximum pool level, the reservoir impounds 160,000 acre-feet of water. It is interesting to note that the only time the reservoir has been filled to capacity was during the flood of 1942, which will be discussed more fully near the end of this article.

Dyberry Creek drains 71 square miles of the northeastern portion of the Lackawaxen Basin. The water arises in the northern and eastern watershed boundaries at elevations of 1500-1600 feet above sea level. The creek flows 16 miles to meet the Lackawaxen and has a total fall of 640 feet. The upper half of the stream and, in general, its tributaries have little stream storage, the banks being formed by hills that rise directly from the water beds. On the lower reaches of Dyberry, however, flood plains have developed and through the years have reached maximum widths averaging  $\frac{1}{2}$  mile.

Weather is another important factor in flash flooding. Like the rest of this highland chain, the climate varies from 103° to a minus 35°F, the annual mean temperature being about 47°F. Annual precipitation averages 42 inches and includes the water resulting from 40 to 50 inches of snowfall. Winter temperatures cause snow accumulation through January and February. This rapidly melts in March as the temperature rises and the rainfall is more or less steady. Consequently the runoff is augmented to such an extent that the streams suddenly swell. Confinement in the upper reaches and the rapid descent of the stream beds add to the water's swiftness until it

#### **EARLY DEVELOPMENT OF HONESDALE AND HAWLEY**

Honesdale and Hawley are located about 10 miles apart along the Lackawaxen River, and together form the principal center of trade and industry in the Lackawaxen Basin. Farming, dairying, quarrying and the manufacture of textiles, ceramics and glass products, leather goods and machinery are the chief occupations. These areas developed as a direct result of the inexpensive transportation facilities offered by the Delaware & Hudson Canal. Built in the first quarter of the nineteenth century, this waterway connected Honesdale with the Hudson River at a point about 90 miles north of New York City. Anthracite coal from mines in the Lackawaxen watershed was sent by gravity railroads to the canal, and thence to New England markets where it played an important role in America's Industrial Revolution. The canal was abandoned in 1899, yielding to a more rapid means of transportation—the railroad.

#### ROOF-BOLTING OPERATIONS

The picture below is of one of four drillers at the face of the tunnel. He is using an Ingersoll-Rand JR-38B stoper mounted on a JL-4 Jackleg with a special adapter feed mechanism designed by the contractor for close-quarter work. While drilling for blasting was being done, he and a helper (right) placed four sets of roof bolts. These are being tightened, in the photograph at the right, with an Ingersoll-Rand Size 308 air-operated Impactool.



#### DRILLING FOR BLASTING

At the face (below), three men drilled hammer-V-pattern holes to a depth of 8 feet. It was done with 9-foot EEEE drill steel of hex section, 1½-inch No. 113 Carset bits and Ingersoll-Rand JR-38B Jackdrills with integral Jacklegs. Drilling time was about 3 hours. When completed, the holes were loaded with Hercules Gelamite dynamite and blasted. According to the records, between 25 and 30 cubic yards of material was drawn with each round.



#### WATER-CARRYING JUMBO

The illustration above shows the Hunkin-Conkey-designed jumbo from which most of the tunnel-work was done. Water was kept in the container beneath the platform rather than outside to prevent it from freezing in the abnormally cold winter. At the top, in the foreground, can be seen the 4-foot rectangular tie-type plates fastened to the rock with 6-foot-long roof bolts. The worker is tightening these with an Ingersoll-Rand Size 308 Impactool.

reaches open country. There it dashes forth, overtopping the banks. Areas subject to the greatest inundation lie in the main stream valley between Hawley and Seelyville, and along the lower 2 miles of Dyberry Creek.

To help retain the rising waters and eliminate flash floods, two dams are being built—Prompton and Dyberry. (The third phase of the \$8,400,000 Lackawaxen project was the removal of three small, nearly worthless dams that were built near Honesdale. These were taken out by the State of Pennsylvania.) The two under construction are of the earth-fill type. Prompton Dam is being thrown across the Lackawaxen at a point about  $\frac{1}{2}$  mile from the main highway crossing at Prompton and 4 miles from Honesdale. The other is being put across Dyberry Creek about  $2\frac{1}{2}$  miles upstream from its confluence with the Lackawaxen River, 1 mile outside the corporate limits of Honesdale and on approximately the same latitude as Prompton Dam. It will control waters from a 65-square-mile area.

Prompton Dam will rise about 140 feet above the river bed, controlling a drainage area of 60 square miles. Its crest will be 1230 feet long, on an east-west line, and its thickness will taper from 800 feet at the base to 30 feet at the top. The structure is to be equipped with a weir-controlled outlet, 505 feet long and  $8\frac{3}{4}$  feet in diameter, running through the west wing, and an open-channel spillway cut out of rock on the west wing. The spillway crest will be 21 feet below that of the dam. At normal stage, the reservoir will have a conservation pool of some 3400 acre-feet and may be used for recreation. At its spillway crest, the capacity will reach 51,700 acre-

feet. The conservation pool shoreline will be 101 feet below the top of the dam. The latest cost estimate for Prompton Dam is about \$3,900,000, and construction started in April. Approximately 730,000 cubic yards of earth- and 40,000 cubic yards of rock-shell will be required before it is completed.

Dyberry Dam will be dry, its prime function being to hold back waters that exceed the flow capacity of its diversion aperture. The dam will be 112 feet high, 30 feet wide at the top and 700 feet wide at the base. Its east-west crest will extend 1280 feet. There will be an uncontrolled outlet works consisting of the rock tunnel and an open channel spillway cut through the east wing. The reservoir, at spillway crest level, will be about 4 miles long, and will cover 655 acres. At this level, it will have a capacity of 24,500 acre-feet, the equivalent of a runoff of 7 inches over its 65-square-mile drainage control area. The embankment will contain approximately 560,000 cubic yards of earth- and 260,000 cubic yards of rock-fill. As with Prompton Dam, local soil deposits will be utilized. Rock for the fill will be obtained from excavation and will be supplemented with local boulders that

were deposited in the area by glaciers. Dyberry is currently estimated to cost \$4,500,000, and construction began on May 9, 1957.

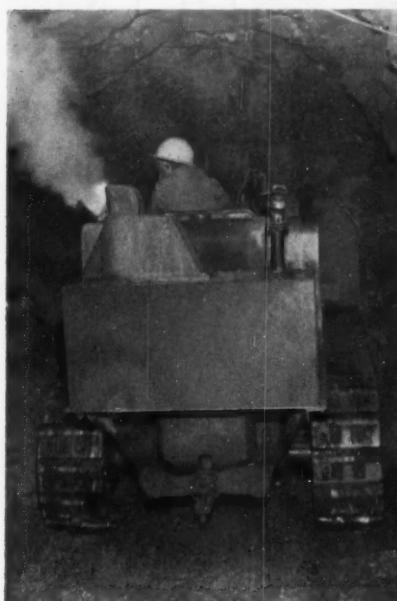
Contractor for the Dyberry phase and its appurtenant structures in the Lackawaxen Flood Control Project is The Hunkin-Conkey Construction Company of Cleveland, Ohio. The contract was let for 3 years at \$1,600,000. Project superintendent is Frank Morgan, and his engineer in charge is J. H. Leckemby. W. A. Blain, area engineer, and Ernest Moon, supervisory construction engineer, represent the Philadelphia (Pa.) District Office of the Corps of Engineers, and Clifford Leutholt is the construction representative for the same office.

Before work on the dam could be completed, the diversion tunnel had to be driven and the creek routed to its new location. Drilling began on December 15, 1957, with L. C. Phillips as master mechanic and E. B. Minser, the tunnel boss. Work proceeded on a 10-foot circular section from both the inlet and outlet sides. No unusual problems were met with the bedrock of shale, limestone and Devonian grey sandstone—typical of that found in the northern Appalachians.



MUCKING

Because of the small diameter and length of the Dyberry tunnel, neither a California switch nor a "cherry picker" could be used. Instead, a Drott front-end loader (left) did the job. It was equipped with a contractor-designed scrubber to eliminate the noxious diesel fumes in the workings. The muck dump (above) was relatively near the headings and is being used as fill for Dyberry Dam. While drilling was being done at one heading, mucking was done at the opposite side. After blasting, the two teams switched positions.



Fourteen men worked the bore on a 5-day-week, 8-hour-per-day schedule. Of these, three were drillers using Ingersoll-Rand JR-38B Jackdrills with integral Jacklegs. These units were selected because they were sturdy, yet light in weight and mobile enough to permit them to be easily transferred from one heading to the other. Drilling was done from a wheeled jumbo-type rig fitted with a single working platform, beneath which was a water container. (It was first planned to put the water supply outside the tunnel, but since the winter was severe, it was decided that if it were placed inside, it would not be as

likely to freeze and interrupt operations.) Each round consisted of 33 holes drilled to a depth of 8 feet and required 2 to 3 hours to place. Nine-foot, EEEE Crucible alloy drill steel, of hex section, and 1½-inch No. 113 Carset bits were used throughout.

While the three men were working at the face, a fourth drilled, and a fifth tightened, roof bolts. For the former an Ingersoll-Rand JR-38B stopper mounted on a JL-4 Jackleg with a special adapter feed mechanism designed by the contractor for close-quarter work, was utilized. Four-foot-long, tie-type rectangular steel plates were set in place with

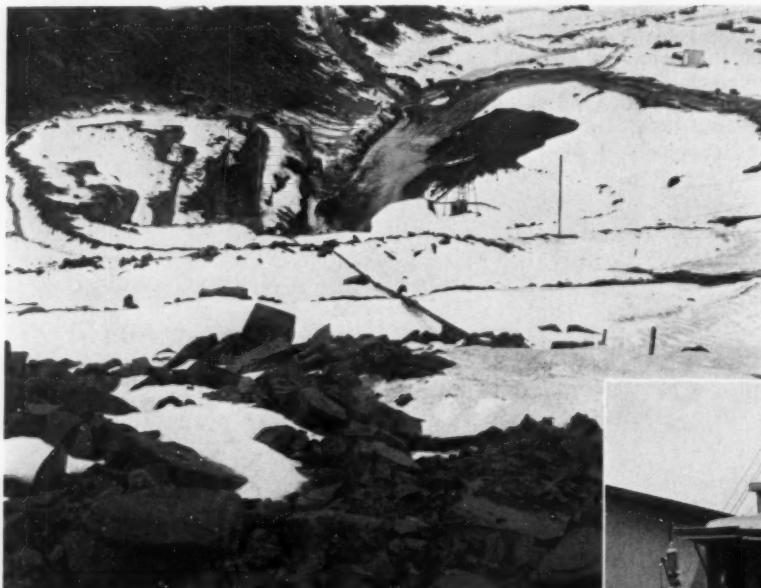
6-foot-long bolts. These were tightened with a Size 308 I-R torque-control Impactool. Four sets were placed during each drilling period. (The initial portions of each heading were supported by timbering.)

After the holes at the face were drilled, they were loaded with 125 pounds of 1½-inch Hercules Gelamite dynamite. The men then withdrew with the jumbo, the round was fired, and the drillers and helpers moved to the opposite heading. Using a hammer-V method, about 25 to 30 cubic yards of material were removed with each round. Although drilling was done to an 8-foot depth, an average of 7 to 8 feet was drawn with every blast. Such records make the fact that the over-all project is now 1 month ahead of schedule seem logical. The tunnel phase was originally to have been completed on June 30.

Because of the working diameter of the tunnel, it was impossible to utilize a California switch, and the short length of the tunnel made a "cherry picker" impractical. Consequently, a Drott track-mounted diesel mucker, of the front-end-loader type, was used. It was equipped with a scrubber, designed by the contractor, to keep from contaminating the air in the tunnel with noxious carbon dioxide fumes. Mucking was done at one heading while drilling was being done at the other. Two hours were necessary to remove the material from each round. Although two of these Drott units were kept on hand, one was held in reserve, the other being all that

#### AIR SYSTEM

Air was furnished to the headings of the tunnel by an Ingersoll-Rand 600-cfm Gyro-Flo (rotary) air compressor (below, right). It was located above the headings of the tunnel, and delivered air to the working faces through 4-inch Naylor spiral pipe sections (below) joined by Victaulic couplings. Typical rough terrain of boulders and outcrops of the Appalachian highlands is clearly indicated.



#### OUTLET VIEW

The view at the left was taken from the heading in the same direction as the water will be flowing. Naylor pipe runs along the center of the right-hand wall and supplies air for the I-R drills. Above it can be seen the ventilating-air supply line. Notice the timbering that was used in the first few feet of the bore. The water is a result of melting snows and rain.

was necessary to remove the blasted material in the scheduled time.

Keeping the tunnel dry presented a relatively small problem, the majority of the water coming from heavy rains and melting snows rather than from the ground. This was readily removed by pumps working through the weekends, and, when rainfall was heavier, at night.

Air was supplied to both headings by an Ingersoll-Rand 600-cfm portable Gyro-Flo (rotary) compressor. So that it did not have to be moved at blast-time, the unit was located well outside and above the entrance to the headings. Air was fed to the face over the rough terrain through a 4-inch Naylor spiral pipe joined with Victaulic couplings.

The tunnel was holed through with no error of closure at 9:50 a.m. on March 6. When completely cleared, it was lined with concrete, mixed in the contractor's on-site batching plant and placed with

movable forms. The finished diameter of the aperture is 8 feet, and there is a 4-foot drop from the inlet to the outlet. Of the total length, 472 feet were drilled on a 49-degree curve.

The tunnel remains open at all times, although provision has been made to drive piles across the openings should it be necessary to close the area for inspection, repair and the like. All of the waters of Dyberry Creek must pass through the tunnel. When the flow is greater than the capacity of the opening, the excess will be retained by Dyberry Dam, thus eliminating the possibilities of flash flooding further downstream, as well as on the Lackawaxen and, eventually, the Delaware River.

It is difficult to estimate accurately the financial value of such a combination scheme as the Lackawaxen Flood Control Project. 1865, 1902, 1936, 1942, 1952 and 1955 saw major floodings of

Prompton, Seelyville, Honesdale and Hawley. (There were many floods other than these, but the cost of damage was never determined, or they were of lesser severity.) The residents of the area—nearly 6000 in all—as well as many others living in fringe localities, suffered heavy property damage and loss, and many were swept to their deaths by the onrush of the water.

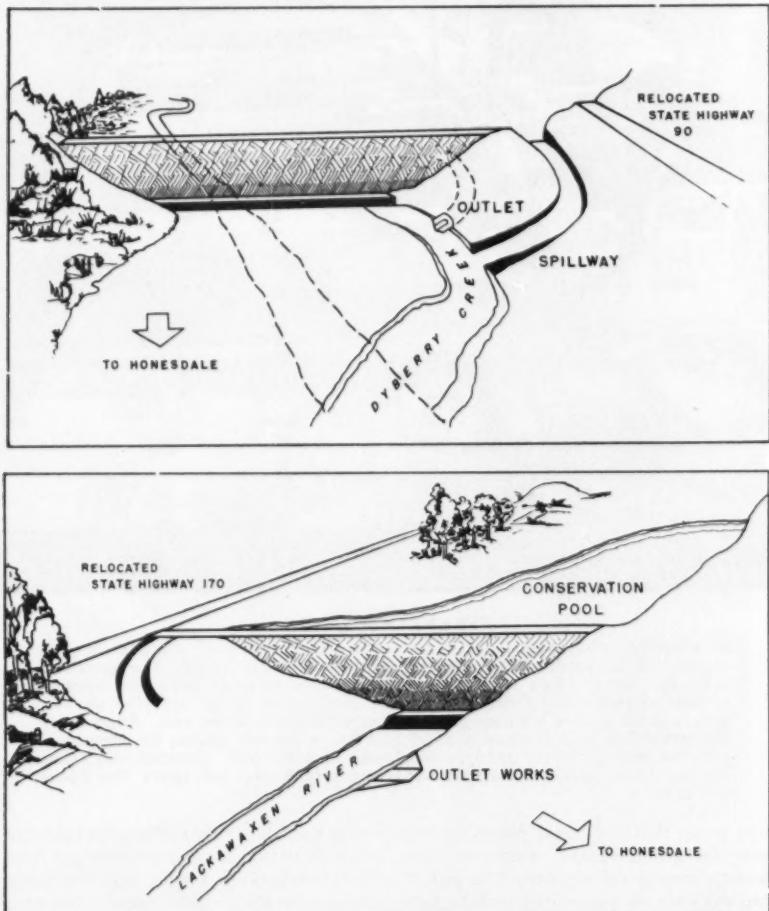
Of the series, the worst was the flash flood on the night of May 22, 1942. Old stone walls along the right bank of the river at Honesdale and Hawley, that had been restored and extended by the Works Progress Administration during 1937-38, were topped, and in many cases, swept away. Four bridges were washed out.

Peak discharge at Hawley was 50,000 feet per second at a gauge height of 20.1\*. This is equivalent to 172 cfs per square mile. At the site of the present Dyberry construction, the discharge was 16,500 cfs, and at Prompton, 13,000 cfs. The Corps of Engineers estimated that if the dams had been in place during the 1942 flood, the discharges at both points could have been reduced to 2020 and 2550 cfs, respectively. Thus, at Honesdale, downstream from the confluence of the Lackawaxen and Dyberry, the discharge would have been reduced from 34,000 to 17,000 cfs, and flood stage would have been eliminated. When the current project is completed, the Army estimates that a flood 40-percent greater than that of 1942 would result in reduced flood stages at Honesdale and Hawley by 11 and 9 feet, respectively.

In Honesdale alone, as a result of the 1942 deluge, 24 lives were lost, residential damage totaled \$2,688,000 and commercial, industrial and utility losses nearly doubled that figure. Total direct and indirect damage between the mouth of the river and Prompton, along the lower 2.7 miles of Dyberry Creek, and on Middle Creek at Hawley, amounted to more than \$6,000,000.

Based on flood frequency, the average total destruction costs amount to about \$528,000 annually. The over-all cost of the flood control program, plus its estimated \$10,500 annual maintenance and operating cost, amounts to \$324,000. The estimated ratio of the annual benefits to this annual total cost of improvement is approximately 1.6 to 1. This does not give a complete appraisal, however. In a period of 14 years, the preventable damages have been more than 80 percent of the total estimated cost of constructing the two reservoirs. More important, the communities in the Lackawaxen Basin will not be as vulnerable to flash flooding and consequently are being given the opportunity to expand commercially.

\*Zero gauge is at 868.7 feet above sea level and was established in 1908 at a point on the waterway where the area drained is 290 square miles in size.



#### TWO DAMS

These sketches are of Dyberry and Prompton dams as they were originally published in a ground-breaking ceremonies program. The one at the top, of Dyberry, clearly shows the original and present watercourse. Highway 90 was formerly to the left of the structure and had to be relocated. Prompton Dam is illustrated in the other drawing. It will have a controlled outlet works and a conservation pool that may be used as a recreational facility. Since these drawings were first published, design modifications have been made.

## CLINTON CORN PROCESSING COMPANY

R. J. Nemmers

**G**RINDING corn is the essential first step in the refining process. It separates the kernels into their component parts and is, in a sense, like the cracking of petroleum, although the former is a mechanical process and the latter, a chemical one. Clinton Corn Processing Company, a Division of Standard Brands, Inc., annually grinds more than 16 million bushels of shelled corn. This amounts to about 35 carloads per day (65,000 bushels) and, like a modern petroleum refinery, work goes on round the clock, throughout the year.

The magnitude of the plant facilities is also the equivalent of a huge oil refinery. Clinton Corn occupies some 40 acres alongside the Beaver Channel Branch of the Mississippi River—a branch formed by Beaver Island. Water for the plant is taken from the river at a rate of 17,000 gpm, most of which is returned after it has served for cooling purposes, but some of which properly filtered and treated, is used in the process and steam generating plant. The plant uses an average of 13,000 kw of electricity per hour produced by a power plant having five boilers with total output of 600,000 pounds per hour of steam at 450-psig pressure. Seven turbo-generator sets are installed, ranging in capacity from 750 to 7500 kw, and exhausting at either 5- or 150-psig back pressure, thus furnishing steam for process use, or discharging to condensers.

The company's 87 buildings have a floor area of more than 1,000,000 square feet, and among the vast tanks, heavy pumping equipment, filters, centrifuges, etc., and in the offices and research laboratories, about 1500 people find work. Within the plant grounds about 6 miles of railroad track are laid. A large, modern research building was recently completed.

**G**REAT train-loads of shelled grain are brought to giant elevators at Clinton Corn. The yellow kernels are unloaded from the cars by cable-operated scoops that dump the grain into a hopper pit just outside the doors. There it is elevated to temporary storage bins from which it flows through cleaners to separate unwanted chaff, pieces of cob and husks. Powerful magnets pick up any



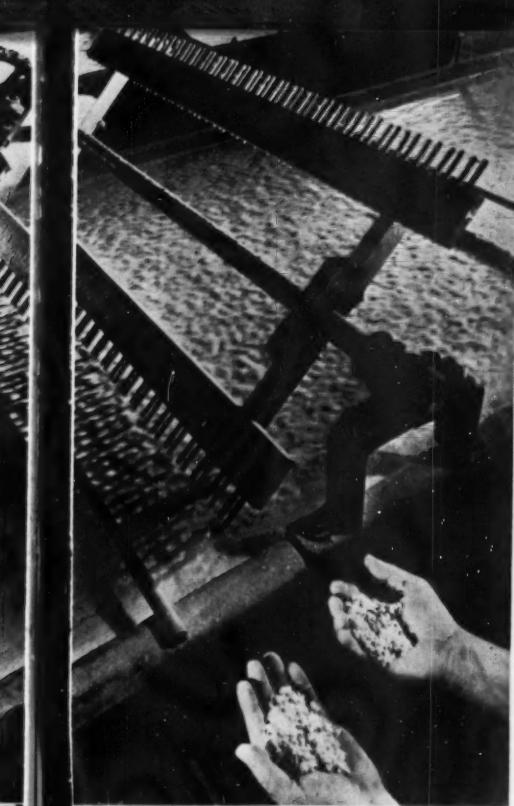
### SEPARATION STEPS

By a flotation process similar to that used in ore concentration, the germ is separated from the starch, gluten and bran after the kernel is ground. The operation is carried out in large settling tanks, the oil-bearing germ being the lightest or floating component. As shown in the photograph at the top, the settling tank is in the form of a trough, and the germ overflows at one end. Afterwards, the remaining pulp is again ground and the starch and gluten are separated from the bran (hulls and grits) on the shakers shown above. Covered with nylon bolting, these pass the starch-gluten-water suspension, but retain the fibers and grits.

iron scrap that may have found its way into the grain. Light chaff and other foreign matter are separated by agitating the corn on perforated metal sheets through which a blast of air is drawn. From there, the grain goes to storage elevators from which, after a second cleaning, day-to-day withdrawals are made by the milling department.

The twice-cleaned corn is put into 2900-bushel-capacity steep tanks where it is soaked for 2 days in warm water

with a small percentage of added sulphur dioxide to prevent germination and most fermentations. (Lactic acid fermentation is one that is encouraged.) Steeping does two things: it softens the hard kernels so that the oil-bearing germ and the starch can be more easily separated from the hull and protein or gluten; and it leaches out any solubles in the corn. (The steepwater containing these solubles is later concentrated and incorporated into livestock feeds.)



#### STEEPING TANKS

In these large (2900-bushel-capacity) steep tanks, corn is soaked for 2 days in warm water. The process softens the hard seed kernels and leaches out solubles.

Steeped kernels are plump and soft—much like so-called sweet varieties that grace the dining table. In this condition, they are easily torn apart, and this is done by passing them through so-called degerminating mills. These consist of contrarotating studded plates between which the corn is passed. The germ is not crushed by this type of maceration. The disintegrated mass is then put into water suspension and introduced to long, settling tanks. The oil-bearing germ floats to the top and flows into an overflow trough at one end. The balance of the corn kernel sinks to the bottom and is withdrawn, still in suspension, for finer milling.

At this point, to the casual observer, everything seems to flow away in all different directions at once. Again, the similarity to an oil refinery is striking. Indeed, about the only basic difference is that at many points the Clinton process equipment is working with solids or suspensions instead of fluids or gases.

**C**ORN OIL makes up about 50 percent of weight of the germ. This part of the kernel, separated in the degerminating mills, is first dried, and then about 70 percent of the available oil is extracted in auger-type presses. The solid

material from the auger press is then flaked, and the remaining oil is extracted by a solvent in which the corn oil is readily soluble. Then, in a distillation tower, the solvent fraction is vaporized and recovered at the top, while oil is withdrawn as a fluid at the bottom. The germ flakes are heated to vaporize the solvent with which they are soaked, and this is also recovered for reuse. The resultant extracted corn oil meal is used as an ingredient of livestock and poultry feeds.

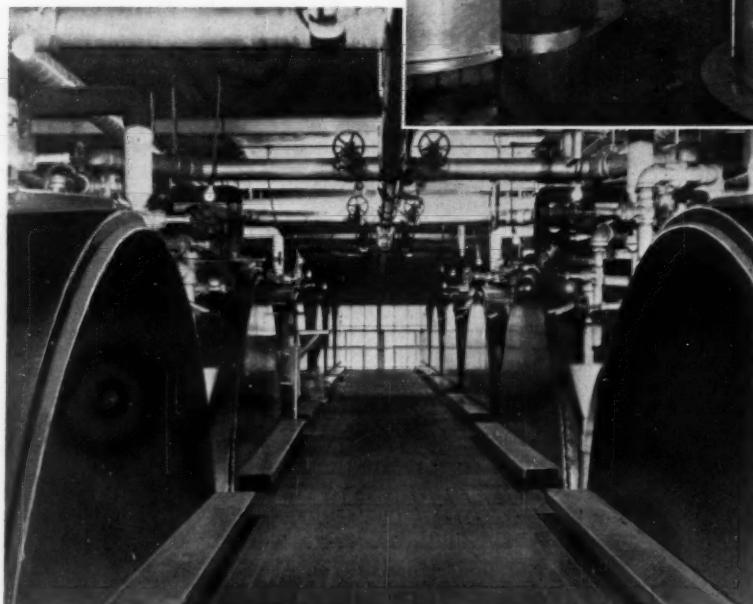
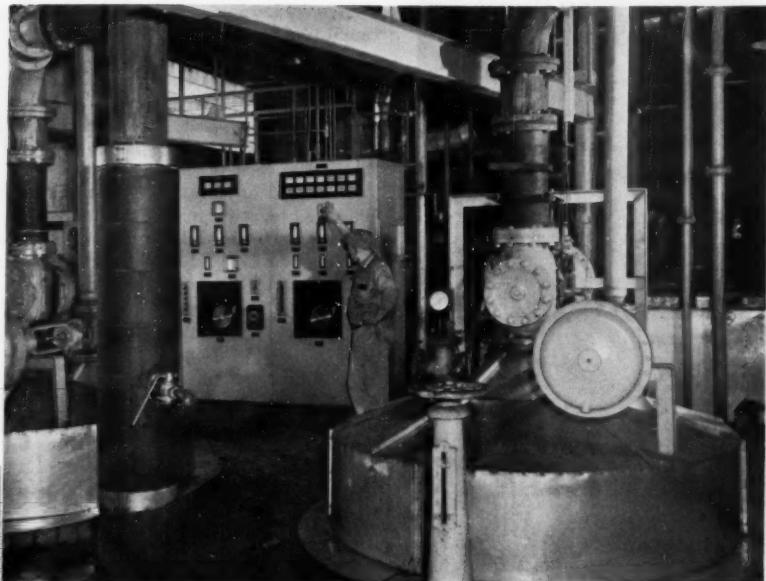
The oils obtained from the pressing step and the solvent-extraction process are combined and then filtered to remove any suspended solids. At this point, the product is known as crude corn oil. The crude, in combination with a strong alkali, is then centrifuged, thus extracting free fatty acids. The resultant residue is called "soap stock," and it is sold to soap manufacturers. The alkali-refined oil is washed with water and then dried under vacuum and passed through beds of activated carbon or clay to bleach it. The bleached oil is then chilled, thus crystallizing waxes, and is filtered to remove them. Next, under high vacuum, the oil is heated and live steam is passed through it. This volatilizes and carries out taste and odor bodies. The end product is a clear, bland, stable oil that is fully edible.

**LIVESTOCK feeds** are primarily composed of the bran—the hulls and so-called grits, and gluten. These materials are by-products from the wet-milling process, and the first step in their manufacture from corn is to separate the starch. This is done in a grinding mill. There starch is rubbed loose from the bran by contrarotating, fluted stone or metal disks. The mills are charged with macerated pulp from the germ-separating tanks, the slurry flowing in at the center and the ground pulp emerging from the outer edges. This is carried, still in water suspension, through a series of revolving reels and vibrating shakers covered with perforated stainless steel sheets or nylon bolting. These sifters screen out the grits and hulls, but permit the finely dispersed starch and gluten to pass through. The screenings, after partial drying, are combined with other by-products including the de-oiled germ flakes, in varying proportions, to make commercial livestock feeds. Steepwater concentrates are also added.

Gluten is separated from the "mill starch," the name for the mixture of gluten and starch that results from the screened pulp. The division is accomplished in centrifugal separators, the heavier starch particles being thrown to the periphery while the gluten is extracted from the center. The gluten, still in suspension, is then centrifuged again to rid it of some of the water.

## CONVERSION AND CRYSTALLIZATION

The picture at the right shows the converter section of the mill wherein starch is hydrolyzed to sugar and syrup. Thirty feet deep and 6 feet in diameter, the converter vessels are of acid-resistant bronze and in operation are required to withstand internal pressures of from 30 to 40 psig as the solution or "boil" is cooked. The other view (below) shows the crystallizer tanks where liquor or "massecuite" is gradually cooled to promote crystallization. The mixture is agitated to prevent solidification into a large cake. Chilled water from a steam-jet refrigeration unit is circulated through jackets surrounding the crystallizers to control the cooling rate.



(Settling tanks are also used to remove some of the fluid.) Then, in filter presses, the gluten is formed into wet cakes. It is next dried and ground to form gluten meal, a high-protein feed ingredient. In some cases, special combinations are mixed to provide foodstuffs high in sugar or vitamin content.

**C**ORN STARCHES fall into five general classifications: common starches, that have no chemical or physical treatment; thin, boiling starches, that are modified with acid; oxidized starches, that are treated with sodium hypochlorite; dextrins, that have been modified by the action of dry heat (roasting), sometimes in the presence of an acid; and starch derivatives, that have been chemically altered in a variety of ways.

Plants in their growing stage build starches by polymerizing basic carbohydrate units. In the manufacture of

specialty starches, Clinton Corn alters or replaces some of these units, splits others and sometimes combines them in different ways.

The basic product, common starch, is produced by washing and filtering the starch suspension that comes from the centrifuges that removed the gluten. The filters that do this job are essentially large cloth-covered drums revolving in a hopper filled with the starch suspension. A vacuum is applied to the interior of the drum, thus drawing water into it. Starch particles build up into a cake on the cloth surface. As the drum rotates, it is sprayed with large volumes of water, which, as it is drawn through the cake, washes out all adsorbed impurities and further removes any remaining solubles left in the starch. As the drum completes a full revolution, the cake is removed and dropped into water. This final suspension is known as starch milk and is ready to be further processed.

For common starch, a final filter cake is formed and dried in a continuous tunnel drier. When it emerges, it is known as pearl starch and often is sold as such. If a powdered variety is desired, the pearl starch is ground.

Redried starch is a variety with a low moisture content—one that is hygroscopic. Laundry starch is the common variety that has been dampened and pressed into lumps or cubes. Refined grits is a term that refers to a starch that has been heated in a water suspension to a point just below that at which gelatinization takes place. When dried, this starch forms hard gritty pellets.

Thin boiling starches are chemically altered substances. They differ from pearl, or thick boiling, varieties in that they form thinner pastes when cooked. They are formed by warming and agitating a water-starch-mineral acid mixture. This breaks down the micellar structure to a certain extent, depending on the strength of the acid, temperature and length of time involved. After that, the solution is neutralized, washed, filtered and dried. Oxidized starch is also a low viscosity material, and it is made by treating a common-starch solution with an oxidizing agent such as sodium hypochlorite. Again, varying conditions of treatment result in a variety of different modifications. Pregelatinized starches are those which have been pasted, or fully gelatinized, and then dried.

Dextrins are made by roasting common starch. Whether or not the process takes place in the presence of small amounts of acids determines the degree of chemical alteration, and thus the physical change.

Starch derivatives are simply chemical combinations of starch with a variety of other substances. Starch has come to

be recognized as a convenient carbon-chemistry building block on which to found the manufacture of products considerably different in physical and chemical characteristics. Some of the preliminary steps in the conversion process are carried out by Clinton Corn Processing Company for other firms, thus supplying an essential raw material for some chemical-process-industry reactions.

**C**ORN SYRUP and corn sugar are derivatives of corn starch. Both rely on a conversion process known as hydrolysis, which is a catalytically induced re-

action in which starch and elements of water are combined. The catalyst is usually weak hydrochloric acid, and as with any catalyst, it does not enter into the reaction in any way itself. The process is essentially one in which the high polymer starch is broken down into simpler (chemically speaking) compounds, such as dextrins, higher sugars, maltose and simple sugar or dextrose. It can be compared to animals' digestive reactions that also convert starches into dextrose for use in body cells.

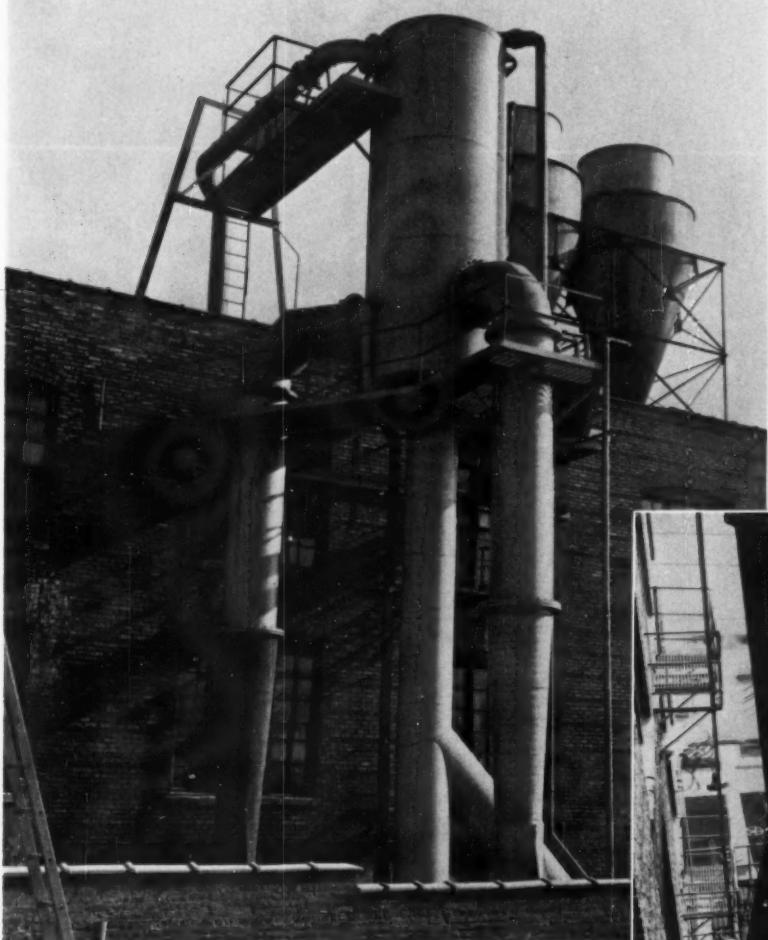
At Clinton Corn the reaction is carried on in converting vessels of acid-resistant bronze. These are some 30 feet in diameter and 6 feet in diameter, and are con-

structed so as to withstand relatively high internal pressures. Acid, starch and water are placed in the converters, and the solution is maintained at its boiling point by the injection of live steam. Pressure within the vessel rises to a maximum of between 30 to 40 psig, and the so-called "boil" is cooked under these conditions for a period of several minutes, the precise timing depending on the end product desired.

Depending on the pH value of the solution, and the length of time it is cooked, syrups of varying sugar content can be produced. By carrying the process as far as is economically practicable, near-complete conversion is accomplished; the resultant liquor can be made to form a solid "crude" corn sugar or a syrup, from which pure dextrose may be obtained by controlled crystallization.

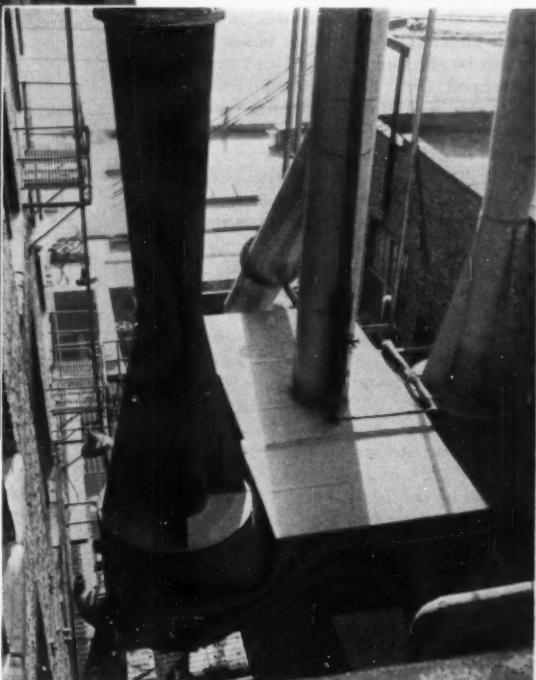
When the solution has been converted to the proper sugar content, the boil or hydrolyzate is run into neutralizing vats where sodium carbonate is added to neutralize the acid. This is carried out under carefully controlled conditions approaching those of a laboratory titration. During the neutralization process, impurities coagulate and are later removed by filtration, the first step in the refining process.

The syrup liquor is then concentrated by passing it through steam-heated vacuum evaporators into a vapor expansion chamber. The syrup is recycled in this phase of operations until it reaches the proper concentration. Then, the concentrate is further refined by filtering through activated carbon, followed by



**REFRIGERATION UNIT**

The unit shown in these two views is an Ingersoll-Rand steam-jet refrigeration unit designed to have an ultimate capacity of 975 tons of refrigeration. In 1946, when the first phase was installed incorporating the cooling chamber, barometric condenser, air ejectors and one steam-jet booster, the unit had a capacity of 325 tons of refrigeration. Clinton Corn now utilizes two of the three jets with which the unit will eventually be equipped. The jets, cooling chamber and foot of the barometric condenser leg are shown at the right. The other view (above) shows the condenser, air ejectors, etc.



final concentration, also under vacuum. An average syrup batch consists of 95 to 105 barrels. The carbon filtering medium is reclaimed (activated) in a Herreschoff furnace where the impurities are "roasted" at a temperature of 1800°F and in the absence of air. Of the corn syrups thus produced at the Clinton plant, almost all are shipped in 8000-gallon-capacity tank cars, with a smaller portion, sometimes of special grade syrups, being marketed in 55-gallon drums. Syrups are normally classified by their D.E. (dextrose equivalent), a high-conversion product having a D.E. of 60 and a low-conversion syrup, one of say, 30.

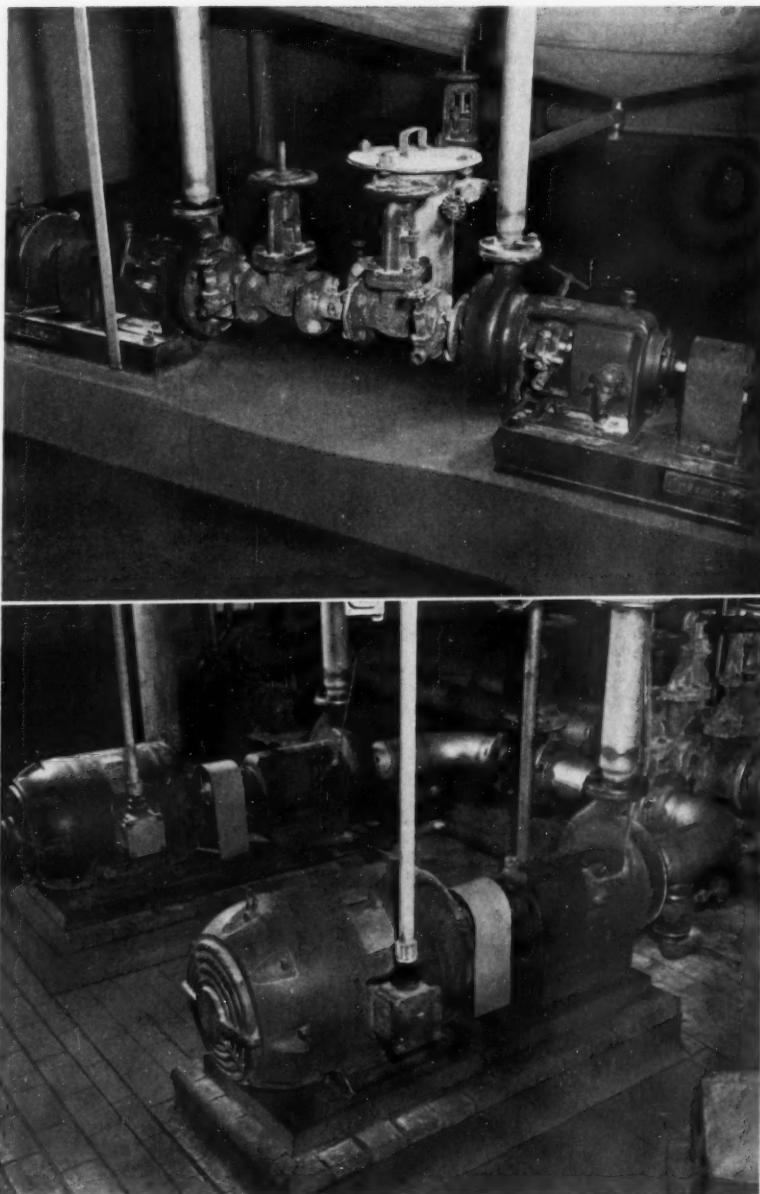
For certain uses, corn syrup is dehydrated. The final evaporator effluent is put into a double-drum vacuum drier where the viscous fluid is picked up on steam-heated rolls and the product dried to a moisture content of about 3 percent. In this form, corn syrup is a dry, white, crystal-like solid. It is marketed in fine granulated form as "corn syrup solids."

Corn sugar production parallels that of corn syrup. After the conversion process, in which relatively more acid is used and the hydrolyzate cooked for a longer period than is the case with corn syrups, the sugar liquor as it is called, is neutralized, filtered and refined, as well as concentrated. Then, the sugar is crystallized from the liquor.

Two general types of corn sugar are made—crude and refined. To make crude, the sugar liquor is cooled in tanks and then run into molds 18 inches long, 12 inches wide and 6 inches deep. There, it is seeded with previously processed sugar granules to hasten the crystallizing, or setting, action. The solid, finished crude sugar may be sold in block form, or can be chipped or flaked and sacked.

Refined corn sugar, or dextrose, is made by essentially the same process except that the sugar crystals are separated from the mother liquor or hydrol. Crystallization takes place in large, jacketed tanks where the liquor is slowly and carefully agitated, over a period of several days, to prevent solidifying and promote crystal growth. During this time the temperature of the "massecuite" is reduced gradually on a carefully predetermined schedule. For example, the temperature of the solution introduced to the crystallizing tanks is about 110° to 115°F. At the end of the first 24-hour period, specifications may call for the temperature to be in the range between 100° and 110°F. This range narrows as the time factor increases; at the end of 4 to 5 days, the massecuite must be in the range from about 68° to 73°F.

This refined sugar solution has also been seeded, and the dextrose crystallizes as fine granules that are carried in suspension in the mother liquor. At this stage the mass has a yellowish color and



#### CHEMICAL PUMPS

Pumps of many characteristics and capacities are required to handle the fluid suspensions at Clinton Corn. Many of the suspensions are acidic in nature, requiring so-called chemical pumps. Shown at the top is a tandem hook-up of two Ingersoll-Rand 1½ MCS stainless steel pumps. They are rated at 60 gpm each against a total discharge head of 50 feet. Utilized in the starch-separation phase of operations, they handle a 15° Baume suspension having a specific gravity of 1.15. The pumps are rated for a maximum temperature of 120° F. Each is driven by a General Electric 3-hp induction motor. Directly above is a view of two Ingersoll-Rand 3 HC units pumping starch suspension to storage. Taking suction from a common header, the pumps have a rated capacity of 300 gpm each when handling a 19° Baume slurry with a specific gravity of 1.15 and discharging against a 125-foot total head. Each unit is driven at 1750 rpm by a Louis Allis 25-hp motor.

is almost a solid mass of dextrose crystals. The magma, as the completely crystallized solution is called, is then centrifuged to separate the hydrol, or mother liquor, from the sugar. The resultant product is a mass of pure dex-

trose crystals firmly caked to the centrifuge wall. It is scraped from the walls by a cutting tool called a plough, while the machine is in relatively slow motion, and is discharged through driers to packing hoppers as fine granules.

To reduce the temperature of the crystallizing solution, great quantities of chilled water are necessary. This is supplied by a giant steam-jet vacuum refrigeration unit designed for an ultimate capacity of 975 tons of refrigeration. In other words, the unit has the capacity to extract 12,000 Btu's of heat per hour for each ton of rated capacity. The steam jet-barometric condenser unit was built so that it would serve the expanding needs of Clinton Corn for some time to come. At its installation in 1946, the unit operated at one-third capacity, or 325 tons. At present, it operates at practically full capacity.

Essentially the unit functions by drawing a vacuum on a water chamber, or plenum, thus causing a certain quantity of the water in the plenum to evaporate. The latent heat of evaporation is supplied by the remaining water in the chamber, thus cooling it. The capacity of such a unit is largely dependent on the degree of vacuum, as well as on the capacity of the vacuum system to eject the water vapor. The Clinton installation, built by Ingersoll-Rand Company, uses steam-jet ejectors to draw the vacuum. When the system originally was installed, one jet was supplied for the required refrigeration. Now, two are in operation.

At full design capacity, the vacuum refrigeration unit operates under the following conditions: chilled water temperature, 50°F; return or recycle water temperature, 71°F; gallons per minute of chilled water, 1125; condenser pressure, 2.56 inches of mercury, absolute; steam requirements at 125 psig, 32,400 pounds per hour for the main ejectors, plus 300 pounds per hour at the same

pressure for the air ejectors; condenser water temperature, 85°F inlet, 106°F outlet; and gallons per minute of condenser water, including the requirements of the air ejectors, 4500.

The unit handles the chilled water requirements for the firm's crystallizers, plus some miscellaneous uses. The unit is one of the largest of its type and is unique in that it is placed on a platform high above the ground. The centerline of the jet-compressor battery is about 30 feet above ground, and the barometric condenser rises another 34 feet. The condenser, of course, depends on the weight of water in a closed leg (34-foot minimum height) to carry water away from the evacuated condensing chamber, thereby eliminating the need for a high-capacity water-removal pump.

Steam, entrained-water-vapor and air from the jet ejectors enter the I-R Disc-Flow condenser at the bottom and flow upwards, through a countercurrent of falling water to an air ejector. Most steam is condensed immediately in the lower portion. As remaining vapors progress through the condenser, they are cooled by the curtain of water. At the top, the air ejectors, also of steam-jet type, withdraw the noncondensable materials and discharge them to the hot well at the base of the condenser.

**LACTIC ACID** is made from corn sugar by fermenting it with pure strains of cultivated bacteria—essentially the same ones that form lactic acid in milk. A simple sugar solution, enriched with protein nutrients, is charged to a fermenter and inoculated with the bacteria to effect the fermentation. After

the process has progressed to a practicable completion point—about a week is required—the ferment is purified and concentrated to the desired degree. Refining is completed by treatment with chemicals and filtering through an activated-carbon medium, after which the final adjustments are made. The end products are shipped to food processors and industrial users.

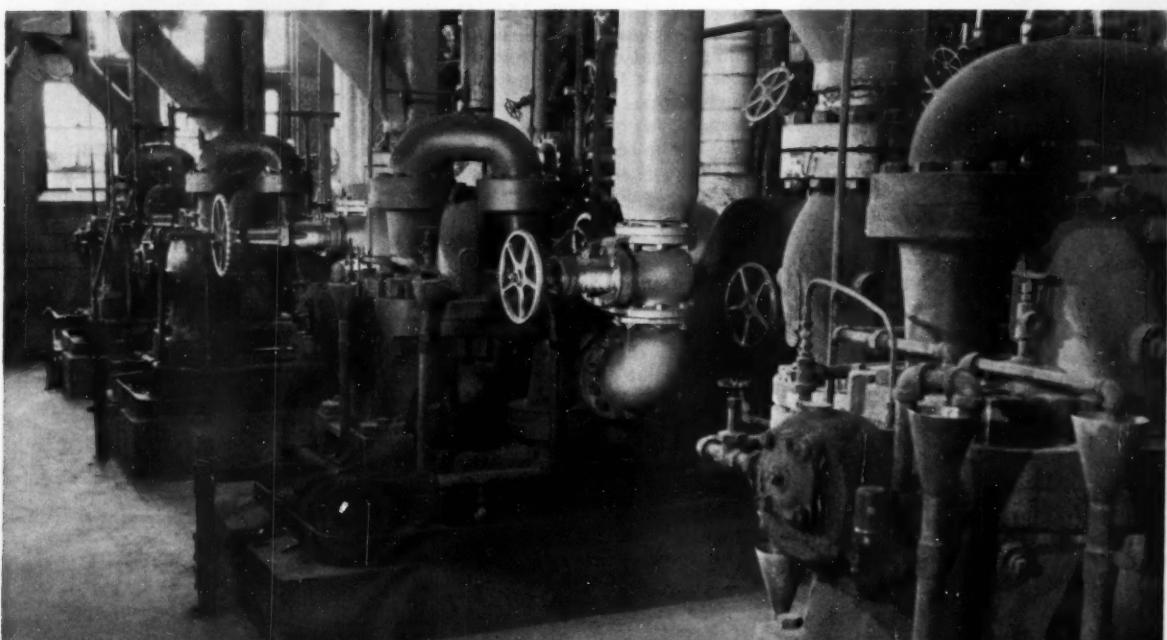
**C**OMPARING corn refining with petroleum refining may seem to be stretching a point. To this, experts in the field ask that we consider the basic component of corn—its starch or carbohydrate content—not as a food, but as a raw material. Petroleum hydrocarbons are made up of carbon, hydrogen and oxygen atoms arranged in certain patterns or groups. So are carbohydrates. The petroleum refiner has found ways of modifying crude oil to make useful products. The corn refiner can also modify the basic starch molecule into products more suitable for man's use and can glimpse ways of making even hydrocarbons from them if necessary. His raw material costs more than does that of a petroleum refiner, but it also can be seen that starch is an annual crop that is renewed each year, rather than a resource that may be exhausted in time.

All of the how's and why's of the carbohydrate conversion process are not known. Their mysteries are being attacked not only within the research facilities of firms such as Clinton Corn, but also by the Corn Industries Research Foundation, an 11-member industry group organized to provide fundamental data on starch chemistry.

#### BOILER FEEDERS

Shown here are four of the six boiler feed pumps serving the Clinton Corn steam plant. Ingersoll-Rand 6-RTS-4 units, each has a capacity of 835 gpm against a total dis-

charge head of 1410 feet. The units are designed for an effective 20-foot suction lift and are steam-turbine driven at 3600 rpm.



## REDESIGNED VALVE FOR ATLAS

A CAST stainless valve, now in use with the Atlas intercontinental ballistic missile, has met rigorous U. S. Air Force specifications at a cost that is estimated to be 30-percent less than an original one that utilized a weldment design. Even more important, it has overcome objectionable features inherent in the weldment.

Working under contract to the U. S. Air Force, Convair-Astronautics, San Diego, Calif., uses the valve in a line running to a high-pressure gas tank. By shutting it, the line below can be cleaned without depressurizing the tank. In this service, the valve and its body are exposed to corrodents at a wide range of temperatures from very low to that close to boiling water. In addition, the device is subjected to gas pressures of 150 psig and considerable mechanical shock.

As originally designed, the valve consisted of welded, wrought stainless steel flanges and tubes. From both economic and engineering view points, however, it was unsatisfactory: machining and weld-



MOLDED STICK

Valve bodies are cast by a centrifugal technique, thus permitting the forming of six bodies at one time. The illustration shows one of these sticks. By utilizing this method, production costs were considerably reduced.



TEST TOWER

Near San Diego, Calif., Convair-Astronautics has a test tower for captive experiments of various missile systems and rocket engines. A variety of high-pressure tanks and lines can be seen in the right foreground.

ing costs would be very high; since weld zones are susceptible to intergranular corrosion, mechanical failure was a possibility; and the welded seams offered an opportunity for gas leakage. Further, there was a question as to whether or not a valve of its design could withstand severe mechanical shock.

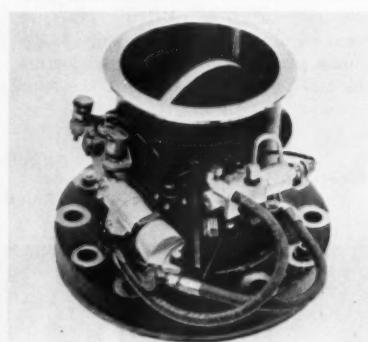
Interstate Engineering Corporation, El Segundo, Calif., to overcome these objections, redesigned the unit to incorporate a centrifugally cast, 1-piece valve body. As a result, not only were the necessary mechanical properties and an improved appearance achieved, but Interstate reports an over-all saving in time and material.

In selecting a suitable cast alloy, the designers had about 20 Alloy Casting Institute designated types in the corrosion-resistant category from which to choose. Type CF-8 (corresponding to wrought type 304) with 19-percent chromium, 9-percent nickel, and a maximum of 0.08-percent carbon, was selected. This alloy, in addition to providing excellent resistance to corrosion by oxidizing media, has exceptionally good impact strength at sub-zero temperatures.

Produced by an ACI member foundry, the valve bodies were made by a modified centrifugal-casting technique, permitting the casting of six 180-pound valve bodies at one time, thus decreasing the production cost per cast unit. Because of the 1-piece cast design, the danger of gas leakage is practically eliminated.

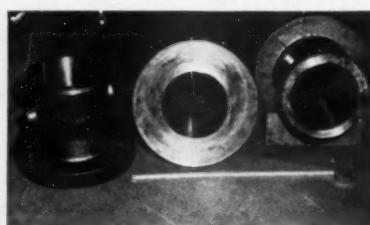
Before the valve was installed, Convair-Astronautics subjected it to tem-

peratures ranging from minus 65° to nearly 500°F. It was also tested for mechanical strength at 2000 vibrations per second and at a stress equal to 15 times the pull of gravity. Reportedly, the valve performed satisfactorily under all conditions.



BUTTERFLY VALVES

Used in conjunction with the Atlas intercontinental ballistic missile, completed butterfly valves, above, are installed in high-pressure gas lines. Each body is made of Type CF-8 stainless alloy and weighs about 180 pounds.



# EDITORIAL

## National Playgrounds



ACATION travels mean a variety of things to different people. For some, the seashore is indicated; others choose the mountains, the lakes of the North, a city, while many stay quite close to home and others travel abroad. In 1957, an estimated 60 million people chose to visit the areas administered by the National Park Service. Americans weren't alone in their desire to visit publicly owned parks in search of fun, health and relaxation. England, Canada and Australia, indeed, most of the free nations of the world, make some arrangements for providing playgrounds for their citizens.

This country takes credit for the establishment of a federally administered park system—the laying aside of scenic, unspoiled lands for the use of all. It is said that once the United States had embarked on the National Parks program, the idea spread throughout the world.

MANY people are responsible for the ultimate development of the park system. A well-documented tale of how the germ of the idea was born exists, however, and it gives credit to Cornelius Hedges for first suggesting that the Yellowstone region be set aside by the government as a public scenic site. The event took place around a campfire on the night of September 17, 1870, according to a diary kept by one member of the so-called Washburn-Doane-Langford Expedition that investigated the area that year. The group had finished its awed examination of the great geysers and smoking lands, and there was some discussion as to how the area could be obtained for private exploitation. Hedges opined that the government instead should retain the land and develop it in the public interest. The rest of the group agreed, and plans were formulated to urge Congress to act.

The Helena (Mont.) *Herald* of November 9, 1870, had an article by Hedges detailing the idea—probably the first published reference to the park project. A bill was introduced simultaneously in the House of Representatives and Senate by Rep. Claggett (Mont.) and Sen. Pomeroy (Kan.) on December 18, 1871. It was passed by both groups, and on March 1, 1872, President Grant signed the bill into law. This was the first of the National Parks as such, although the springs at Hot Springs, Ark., had been set aside for the healthful "use of all citizens of the nation" 40 years previously.

THE NATIONAL Park Service was established by Act of Congress, August 25, 1916, an enactment that made provisions for the establishment of additional parks as well. Also coming under the administration of the Service

are the National Monuments, reservations established by presidential proclamation under the so-called Antiquities Act of June 8, 1906.

Today there are a total of 29 National Parks. The most recently established one, in the Virgin Islands, joined the group late in 1956. In April of this year, the nation's only National Seashore Recreational Area, encompassing three islands off the coast of North Carolina, was formally dedicated. Including Bodie, Hatteras and Ocracoke islands, the 45-square-mile area is one of the few stretches of undeveloped and unspoiled beachland on the whole of the East Coast. The National Seashore includes the Kitty Hawk Monument, site of the Wright Brothers' famed experiments with heavier-than-air craft.

In addition to the Parks and the Seashore, there are about 150 other federally administered monuments, reserves, military parks, recreational areas and memorials. All told, these public lands encompass 24,397,985 acres. By far the largest of all is Yellowstone National Park with 2,000,000 acres of the 13,130,738 devoted to National Parks. At the close of the last tourist season (September 1, 1957) some 45.5 million people had visited the National Parks. As we have said, the total for all of last year is estimated at 60 million.

DEVELOPMENT of these lands continues with the establishment of adequate roads, potable water supplies, campsites and swimming and hiking areas. In the interests of preserving some areas untouched by civilization, the Service has decreed that they be closed except to those willing to enter on foot, on horseback or by canoe trails. Besides the investment of public monies, most of which is amply covered by license and concessionary fees, private interests providing hotel and motel accommodations, eating establishments, etc., within the confines of the parks on a concession basis, put some \$7,200,000 into the further expansion and maintenance of their facilities.

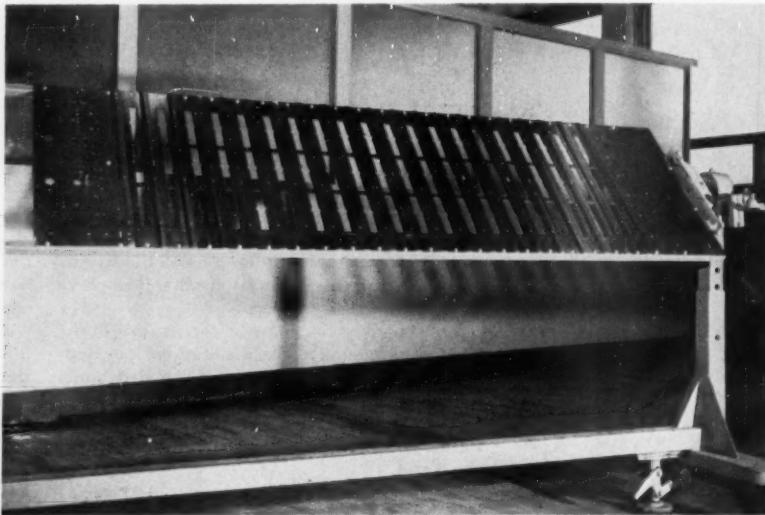
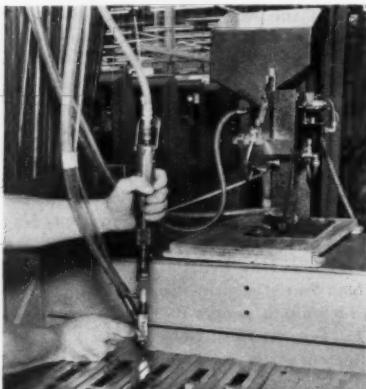
Although the avowed purpose behind the National Parks and Monuments is not one of commercialization, the economic benefits are indeed striking. From a conservation standpoint, the maintenance of forests is important to present and future lumber supplies and also provides great protection to important watersheds. The money spent by tourists pours millions into the cash registers of establishments surrounding the parks and additional large sums into the State and Federal coffers in the form of taxes.

The benefits considered most important, however, are those dealing with the health, relaxation and education of the citizens of the country. It has frequently been said that the setting aside of these lands and historical sites is indeed a measure of the greatness of the country and her people.

## SAVING WITH AIR POWER

# Pneumatic Tools Reduce Computer Assembly Time

IT HAS been found at International Business Machines Corporation's Kingston, N.Y., plant that efficiency can be substantially increased in the production of computers for its Sage System by using automated, air-operated fastening equipment on its assembly line. Formerly, the fifty-one 10-32x  $\frac{1}{2}$  slotted pan-head Sems screws were



### ASSEMBLY OPERATION

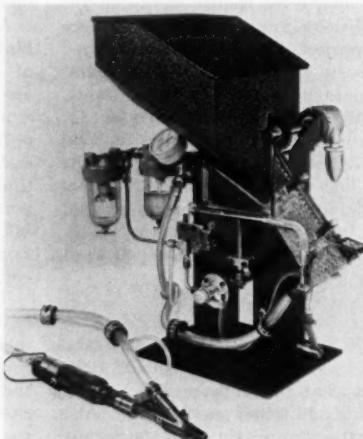
By eliminating all hand placement of screws, the General American Transportation Corporation Jet-Setter (left) is saving 30 percent of the time formerly required to install top plates and panels on computer frames produced by IBM. Each completed panel (above) requires 51 slotted pan-head Sems screws.

started by hand and driven with a power driver. Now it is reported that the time required for assembling top plates and panels to computer frames has been reduced by approximately 30 percent, as a result of the use of Jet-Setter, a high-speed screw-feeding device manufactured by Parker-Kalon Division of General American Transportation Corporation. It is adapted to an Ingersoll-Rand 00B1LC21 screwdriver and incorporates a conical, plastic-covered head that is designed for automatic use in extremely confined locations. The adoption of this portable equipment enables an operator to run fasteners at any point along the 6-foot length of a typical computer frame without moving the frame itself. It is claimed that there is an unmeasurable saving in operator fatigue and a virtual elimination of screw loss.

#### JET-SETTER

The tapered plastic-covered head on the unit (right) permits automated driving of threaded fasteners, including those with preassembled washers, in extremely confined locations. The box at the top holds the screws, which are fed, one at a time, through a plastic hose to the Ingersoll-Rand 00B1LC21 screwdriver (left foreground). The entire device was demonstrated at the Design Engineering Show.

The Jet-Setter is controlled by a pneumatic "brain center" that permits only one screw at a time to be fed from the supply hopper to the driving head. After one screw has been driven, the next is blown through the transparent plastic tube to a 3-jawed screw-hold device where it is gripped as in a drill chuck. This retains the fastener in driving position, regardless of the driving angle, so that the screw itself acts as a finder or drift. Each is started and driven in one operation.



### Eliminating Complaints

AIR conditioner manufacturers have been plagued by complaints of faulty connections that appear after units are installed. The flaws allow refrigerant to escape, and develop from the jolts of shipping, even though the linkages previously withstood a 400-pound-per-square-inch pressure test at the factory.

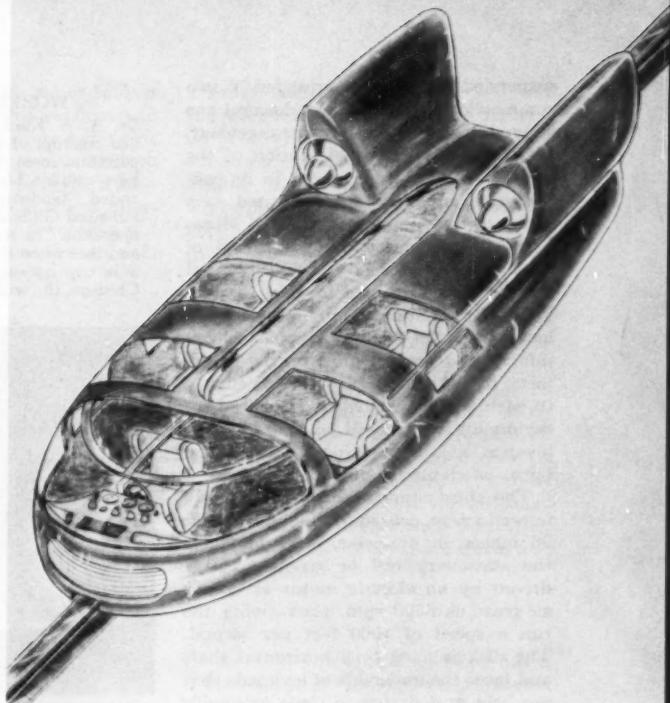
To eliminate these failures, even though infrequent, The Cleveland Vibrator Company fabricated a vibrating roller-conveyor section to be placed in the assembly line just before the pressure-test booth. It consists of a standard roller conveyor top and base, with a 3-inch LS vibrator bolted to the top longitudinal structural member. Operating on 80-psig air pressure, the LS delivers 1000 blows per minute. The roller top of the device is supported by four, stiff, coil springs that serve to both amplify the vibration and, at the same time, prevent blows on the floor. As the air conditioners move along, they are shaken violently for 1 minute. Any potential weak points are thus loosened enough to appear during the pressure test. Then the flaws can be corrected before the units are shipped for customer installation.

#### ARTIST'S CONCEPTION

This may well be what the wheel-less Glideair vehicle of the future will look like. Balanced on a single rail by gyroscopes, it will be capable of speeds up to 500 mph. Other applications include its use on twin rails, as well as over roads. Ford Motor Company engineers claim that the latter is impractical, considering the speed and human reaction elements.

# GLIDEAIR

*Thin Film Of Compressed Air  
Replaces Wheels On New  
Ford Motor Company Project*



COMPRESSED AIR has served man in a variety of ways to make his tasks easier and his efforts more efficient. In more remote history, the wheel was developed for the same purpose. Now, the wheel may be replaced, at least in the realm of long-distance, high-speed, overland transportation. The present status of the wheel has been compared to that of aircraft directly after World War II. At that time, the British Spitfire, the German Messerschmidt, the American P-51 and the Japanese Zero

were the ultimate in high-speed aircraft. The need for faster travel over greater distances gave way to the era of jets. So the wheel is stepping aside for compressed air.

As early as 1928, Dr. Andrew A. Kucher of Ford Motor Company proposed that vehicles could travel faster if a film of air were applied as a sort of lubricant, not in the sense of conventional oil lubes, but as a separating medium between the vehicle's surface and the stationary path over which it

passes. Recently, he has given substance to this theory in the form of a 3-foot-long working model called Glideair. In lieu of wheels, he used perforated aluminum disks, and named them levapads. Through the small holes, tiny streams of air are passed, thereby raising the vehicle approximately 0.003 inch above the ground, or, as in the case of the model, a table top. Consequently all road friction is eliminated, leaving wind as the only resistance factor.

Levapads are basically of flat-disk design, however some models have been made to fit over and around the top and down the sides of rails. The air jets from the top raise the vehicle above the rail, while four others, two from each side, prevent scraping along the rail's web. The air pressure exerted from these five positions acts much like a clamp.

In collecting fundamental information about the levapads, two test stands have been devised to measure pressure requirements and vibration. A third unit is being assembled that will yield information about the pads' capabilities in simulated travel.

In the first testing device, the pad was equipped with a series of manometer taps, and the air pressure pattern was determined. An orifice meter measured air flow. Very high air velocities, usually sonic and sometimes supersonic, were found in the gap between the pad and the permanent surface. It was learned that the amount of pressure required to maintain the gap varied with the size of the levapad and weight of the vehicle.

The vibration tester was made of a spool with its two flat surfaces clamped between two levapads. The spool was



#### LEVAPADS

On the underside of a Glideair, as seen through this glass table "roadway," are three levapads. Through these perforated disks pass jets of compressed air at a pressure great enough to raise the vehicle slightly off the stationary surface. Thus, all road friction is overcome, air resistance being the only slowing factor.

suspended by six wires arranged in two symmetrical groups of three, located one above the other. Thus, by arrangement, there was no horizontal motion of the spool. Weights were placed in its central tube, and the area was used as a dash pot for damping; periods of vibration were increased and sharpness of resonance, diminished—the vibrational energy being absorbed in fluid friction. With a capacitative proximity pickup located in the bottom levapad block, information was provided on the movement of the pad. Since the air supply to each was controlled and metered individually, tests could be made on one levapad as a supporting fixture, or on both, as clamping devices.

The third stand, which is currently in production, consists of a spinning disk, 36 inches in diameter, that simulates the stationary rail or ground. It is driven by an electric motor at speeds as great as 6300 rpm, thus giving the rim a speed of 1000 feet per second. The disk is fixed to a horizontal shaft and faces the underside of levapads that are held in a fixture in close proximity to the disk itself. The device can hold one, two or three of the pads at a time. As the wheel spins, measurements will be made on the pad load, the motion of the pad and the forces in directions perpendicular to the load. To simulate surface imperfections of a rail, as well as a waving motion that will be encountered under actual application, the stand is equipped with an eccentric crank mechanism to allow oscillation of the disk along its axis. A counterbalance arrangement prevents transmission of the vibrations beyond the bed-plate of the testing stand. It is anticipated that oscillation will approach 400 cycles per minute, and amplitudes attained will be as great as  $\frac{1}{8}$  inch.

Air for both the levapads and the Glideair itself will be provided by a gas turbine or a turbojet—the propelling motion being the result of the law of reaction. It has been calculated that

#### WORKING MODEL

Dr. A. A. Kucher, who first outlined this concept of high-speed land transportation some 30 years ago, is shown here with his 3-foot-long working model called "Glideair." He has said that full-sized Glideair vehicles could be in operation "in the foreseeable future," and that when they do arrive, the 300-mile trip between Detroit, Mich., and Chicago, Ill., will take less than an hour.



about 50 hp will be needed to lift a 1-ton vehicle. However, once it is supported by the air, it will take only an additional 40 hp to move it 100 mph. It makes little difference as to what the weight of the vehicle is, once it is floating. For example, if a 1-ton and a 50-ton unit were being driven, both offering the same frontal area to wind friction, it would require only slightly more power to drive the latter at the same speed as it would the former.

Power requirements increase, of course, as the speed increases. To travel at a 400-mph rate, 800 hp will be required. This was described by David J. Jay of Ford as being "extremely small"—a  $4 \times 1 \frac{1}{2}$ -foot packaged, low-speed turbojet engine could develop 1000 pounds thrust.

In comparison with a 4-engine passenger airliner, such as the DC6B, Glide-

air requires 2500 hp to levitate (50 hp per ton), whereas the airplane would need each of its four 2400-hp engines, the weights of both vehicles being approximately 100,000 pounds. In flight, the aircraft would use its total 9600 hp for locomotion, whereas Glideair would need only an additional 1800 hp (to its initial 2500-hp lifting requirement) to propel it at 400 mph. At the same time, no consideration has to be given to heavy wings and tail sections on the Glideair. On the aircraft, these make up about 60 percent of the drag. All the weight normally allowed for these parts can be utilized for additional payload capacity.

How fast can the Glideair travel and where will it be used? It has been estimated that it will have a speed ranging from 200 to 500 mph. It is difficult to imagine such a ground speed. For comparison, in the famous 500-mile race at Indianapolis, Ind., automobiles often attain 185 mph on the straightaways. Some have claimed that similar speeds would be commercially practical, however it must be remembered that during the Indianapolis race, each car stops at least once for a change of tires. As for railroads, it is known that steel wheels are incapable of withstanding similar sustained speeds. Vibration, loss of traction and control are but three problems encountered. In view of this, design engineers at Ford Motor Company state that the use of levapads on Glideair is impractical for highway vehicles. They are primarily concerned with the development of the models for rail travel, either over conventional dual tracks, or the more recently popular monorails. Control would be in an electronic sensing system, rather than depending upon human reaction. Braking would be either mechanical or magnetic, or by water scoop or reversing engine thrust. When put into working order, it is expected that Glideair will be able to move people and material from, say, Detroit, Mich., to Chicago, Ill.—a distance of some 300 miles—in less than 1 hour.

## This and That

The latest recognized Beep-Beep's standard properties of Graphically the earth's atmosphere, Illustrated from sea level to 2,000,000 feet, have been charted by the scientists and engineers of The Garrett Corporation's AiResearch Manufacturing divisions, in two colorful graphs—an Atmosphere Chart and a High Altitude Chart. The information contained on the two is being confirmed by the beep-beep-beep's of the Russian and American satellites, and represents more than 200,000 calculations and in excess of a year's research. The Atmosphere Chart, which has been published in progressively expanded versions four

times since 1942, represents values of temperature, pressure and specific weight of the atmosphere from sea level to 100,000 feet, or within the normal area where "air-breathing" aircraft fly. With the advent of the space age, specific weight and pressure scales needed expanding. Thus the second graph was drawn. It contains values of acceleration of gravity, molecular weight and real kinetic temperature computed from sea level to 2,000,000 feet in 10,000-foot intervals. Two original paintings by Chesley Bonestell, familiar to science-fiction readers for his illustrations of planets other than ours, form the background.

For the individual who wishes to keep abreast of the fast-changing age of space probing, the U. S. Air Force's new glossary of terms would perhaps be useful. The publication has been prepared by the Air University and spans a verbal horizon—if that word has meaning any longer—from AAM to Ziolkowski. The three letters stand for "air-to-air missile" and the other is a variant of Tsiołkowski, K. E., a Russian engineer and scientist who lived between 1857 and 1935. He published a paper, *Rockets into Cosmic Space*, in 1903, that is regarded as one of the pioneer works in

the achievement of rocket flight. According to the glossary, "unobtanium" is a substance that either theoretically cannot exist or cannot be produced because technology isn't up to it just yet. Italics explain that the definition of this word is ironic or humorous. "Auntie" is slang for antimissile missile, and "post-sputnik" pertains to the time after the launching of the first man-made satellite. The Air University hesitatingly recognizes the "vanishing man concept." This is described as a "concept of warfare that visualizes more and more use of robots, machines and automation with corresponding use of fewer and fewer men." In small print, the glossary comments, "This concept is not to be considered necessarily valid."

\* \* \*

**In the Yukon and Work Begins Northwest Territories On Far North of Canada, major developmental road projects that call for the construction of more than 1200 miles of roadway, six major bridges and scores of lesser ones are now getting underway. Total estimated cost of the recently announced work is more than \$31 million. Most of the roads have been routed to, or through, major areas of minerals exploration or to assist in lumbering**

operations. Three of the major bridges will replace summer ferry services and winter ice bridges on existing roadways, thereby opening their respective roads to year-round service. At present, freeze-up and break-up on these rivers interfere with road use about 3 months out of the year. The three structures will cost an estimated \$3,500,000.

\* \* \*

**Bird-like 'Plane Wings** Man has moved another step closer to Nature in the field of aeronautics. Now a pilot can move his airplane wings to take advantages of different flight conditions.

The advantages of a "flapping" wing, according to D. M. Bland, engineering specialist for Chance Vought Aircraft, are good visibility for landing without the need of a canopy above the fuselage and shorter landing gear because the airplane's fuselage need not be tilted on take off and landing. In addition, the shorter landing gear requires less space in the craft, yielding obvious advantages in weight, location of other equipment and increased fuel capacity.

The wing-moving mechanism is described as a 30-pound hydraulic actuator. (Similar units are already in use in the U. S. Navy's F8U-1 Crusader fighter.) When the pilot moves a lever,

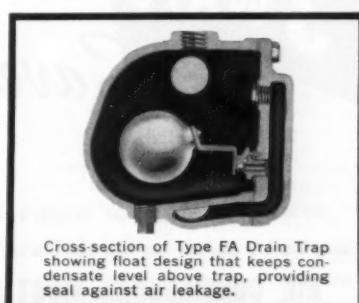
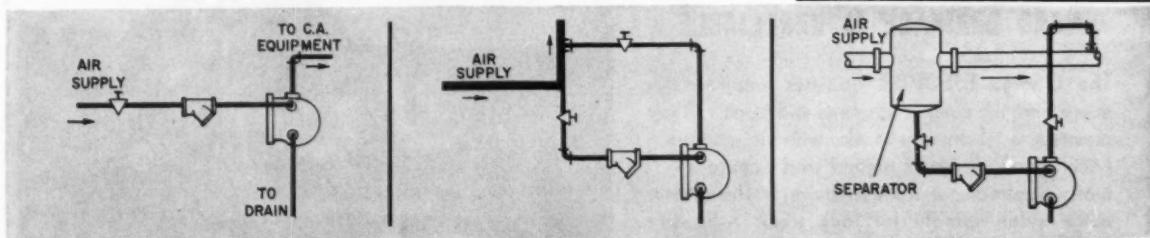
a spring-loaded brake is unlocked, and the mechanism rotates, moving the wing up or down. A loss of pressure during actuation causes the brake to reengage, locking the actuator at the position where pressure is lost. To prevent very fast and potentially unsafe operation, the actuator has a built-in relief valve. In case the normal operating system fails, the wings can be moved with pneumatic pressure obtained from air bottles. Since the actuator extends to raise the wing to the landing position, and since the extension area is, by its nature, quite large, the air pressure can be reduced and used at a lower pressure for weight saving. To prevent accidental locking of the wing before it is fully lowered, the pilot has a spring-loaded plunger that prevents any premature movement of all the actuating parts that are concerned.

\* \* \*

**Transporting Humans By Conveyor** Houston, Tex., has a moving sidewalk that transports visitors 114 feet across the Buffalo Bayou to Houston Coliseum. It has carried more than an estimated 2,000,000 persons since it was installed in February 1955. It is 82 inches wide and travels at a speed of 132 feet a minute while rising 12 feet to

## INSTALL NEW SARCO FA DRAIN TRAPS

*and get more work from your CA tools*



Cross-section of Type FA Drain Trap showing float design that keeps condensate level above trap, providing seal against air leakage.

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age to tools from impaired lubrication and waterhammer. It avoids slowed-down production resulting from freezing in tool exhaust.

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deliver passengers into the coliseum. It is said to be the widest conveyor belt ever used commercially to transport humans and is a product of B. F. Goodrich Industrial Products Company.



Akron, Ohio. The moving sidewalk has sidewalls that are 3 feet high and enclose the moving path on both sides. Its handrails are synchronized with the speed of the belt. Passengers step on and off as if it were an escalator. It is 230 feet long,  $\frac{7}{8}$  inch thick and has seven fabric plies for interior reinforcement.

ment. A specially compounded rubber cover provides scuff-resistance, and officials state that there is no sign of wear despite its severe service. During events at the amphitheatre, the area is filled with more than 12,000 people, and 50 percent of them enter and leave via the conveyor. City officials report that it keeps the crowd moving efficiently and safely.

\* \* \*

Air Device  
Helps Missile  
Hold Course

A regulator for control of pressure in compartments housing electronic guidance equipment aboard guided missiles is designed to prevent the guidance equipment from destroying itself. The regulator maintains approximate sea level pressure in the compartment. Without this control, the guidance devices would be subjected to destructive electrical arcing at the low pressures found at high altitudes. The unit weighs  $\frac{3}{4}$  pound, is 3 inches high, has a housing diameter of  $2\frac{1}{4}$  inches and an attachment flange that is 4 inches

in diameter. The regulator is essentially an outflow valve operated by a spring and an evacuated bellows. As the unit is carried to higher altitudes, faster flow of gas from the compartment to the atmosphere results in lower pressure on the bellows. The bellows expands, assisted by the spring, and this closes the opening to atmosphere, keeping the chamber at a constant pressure. The regulator was developed by the AiResearch Manufacturing Division of The Garrett Corporation in Los Angeles, Calif.

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Tunnel From Shelter After World War II, the city of Stuttgart decided to spend about \$3,000,000 to convert an air raid shelter that was built in 1941 into a vehicular tunnel for 2-lane traffic under a hill in the city. The work was recently completed, and the structure stands today as Germany's longest such tunnel, being 3000 feet in length and 25 feet wide.



Saves...

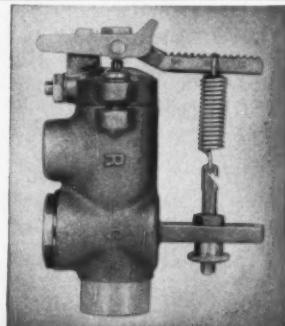
## CONRADER'S REBUILT UNLOADER VALVE REPLACEMENT SERVICE

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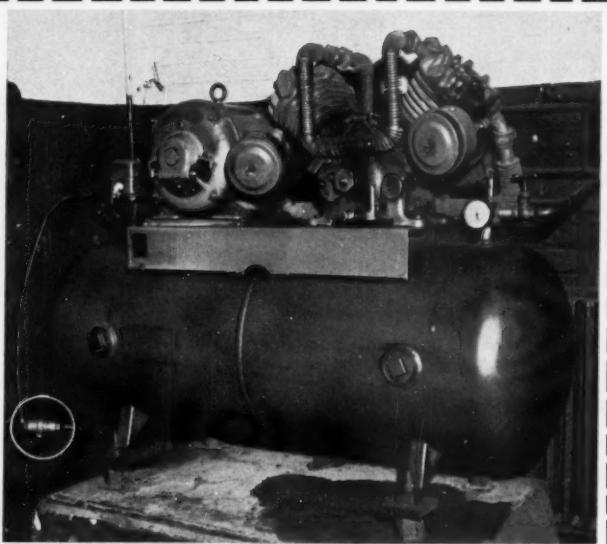


### AIR COMPRESSORS MUST BE DRAINED HAND DRAINAGE IS UNRELIABLE

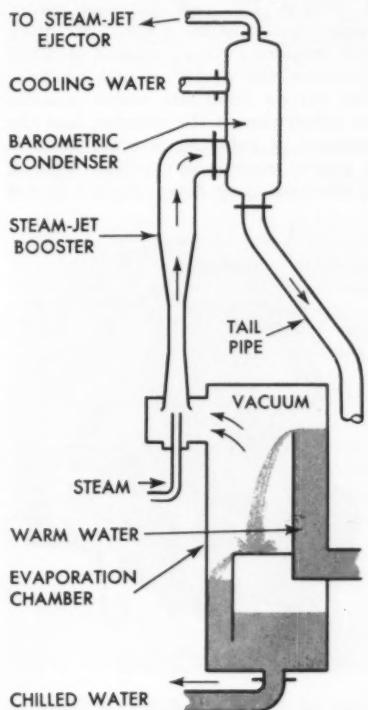
The George EJECTOR operates automatically every time the compressor starts and stops. They maintain a clean dry tank without attention. Mechanical design is rugged and simple . . . easily applied . . . inexpensive. The ejector has a nylon spindle for long wear. Specify George ejectors on your next compressor order.

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How to  
**CHILL WATER**  
 With  
**STEAM**



**I-R Steam-Jet Coolers** chill large volumes of water down to temperatures as low as 35 F, with no power but steam—and no refrigerant except water. The simplicity, economy, dependability and safety of water-vapor refrigeration makes it the ideal solution to process cooling problems wherever steam is available.

The cooling action is achieved by evaporating a small portion of the water to be chilled, in a vacuum chamber which is evacuated by a steam-jet ejector. The ejector can discharge into either a barometric or surface condenser. Overload capacity is higher than with any other system. And no special foundations nor vibration-isolating devices are required.

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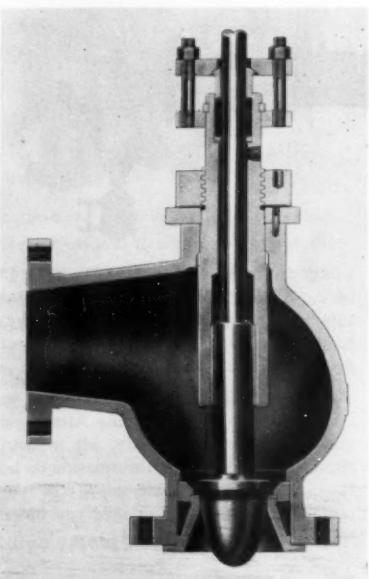
**Ingersoll-Rand**  
4-775 11 Broadway, New York 4, N.Y.

JUNE 1958

**Industrial Notes**

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*Ingersoll-Rand Company, 11 Broadway, New York 4, N.Y.*

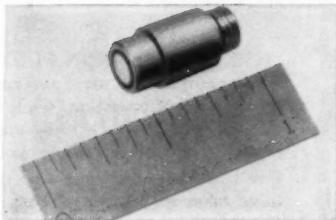
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**NEW PRODUCT NEWS**



Model PZ-14



Model PZ-6

**Kistler Gages Measure Engine Knock and Detonation Pressures**

Quantitative measurements of pre-ignition, detonation, and other abnormal combustion pressures can now be made under the most severe engine operating conditions with the new Kistler SLM Electronic Pressure Gage. Designed to measure either pressure or pressure rate directly, the one basic Quartz Gage (Model PZ-14) also indicates compression, peak firing, manifold and fuel injection pressures.

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A new console model which includes associated Kistler Pre-Amplifier-Calibrator units, electronic switches and oscilloscopes, displays up to eight cylinder pressure signals simultaneously. Simple gang connectors (summing units) permit eight pressure rate signals to be superimposed on the screen.

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*Kistler Instrument Corp., Dept. C.A., 15 Webster St., North Tonawanda, N.Y.*

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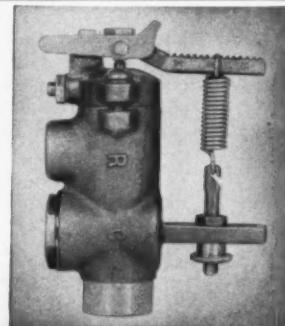
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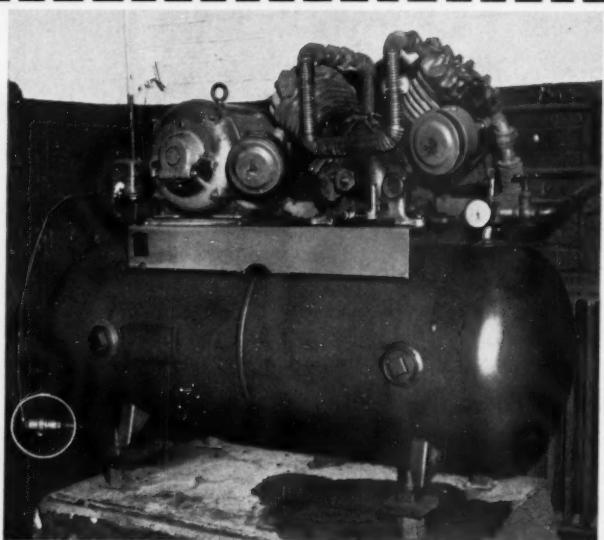


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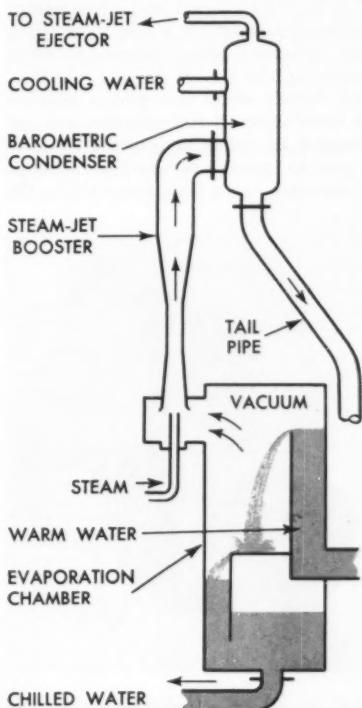
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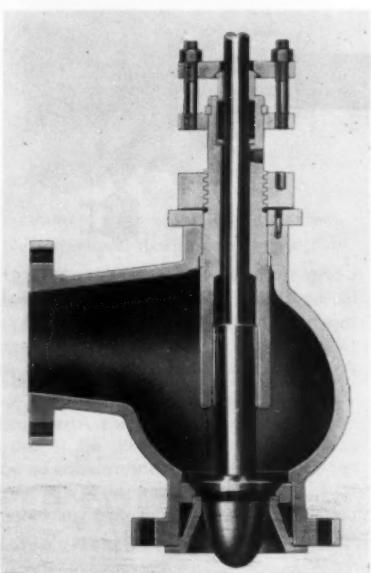
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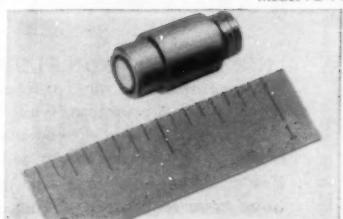
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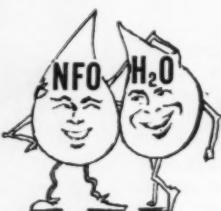
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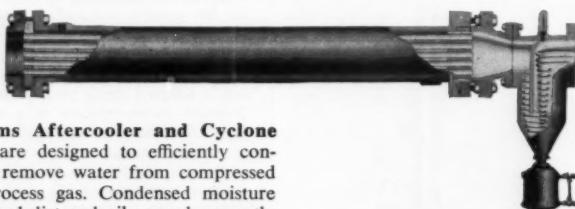
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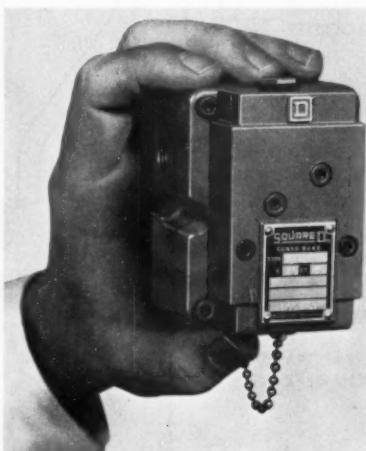
**Adams Aftercoolers and Separators** are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

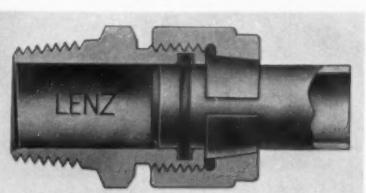
ASA ratings to 2500-psig pressure; 6- and 8-inch sizes, to 1500-psig pressure; 10-, 12- and 14-inch sizes, to 300-psig pressure. The valves can be used for handling erosive and corrosive slurries; coking oils and liquids; high-pressure pipeline gases, steam and water; and for boiler-feed water control and the like. *Conoflow Corporation*, 2100 Arch Street, Philadelphia 3, Pa.

PNEUMATIC tool and spot welder applications exist for a 4-way air valve that includes a rotary magnet to allow mounting the device in any position. The valve's small size makes possible its installation at the cylinder, and the presence of balanced internal pressure is said to increase service life. Change of direction in air flow, actuated by the



unit, reportedly takes place in less than ½ cycle at 60-cycle frequency. Full ¼-inch porting is provided throughout. It is constructed to JIC specifications and includes an oil-tight enclosure and provision for optional manual operation. The valve is available in a special enclosure for direct mounting on gun welder cylinders. *Square D Company*, 4041 North Richards Street, Milwaukee 12, Wis.

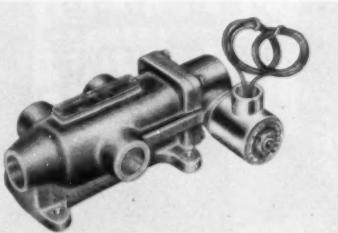
VACUUM, air and hydraulic systems are suited to a tube fitting that seals with a standard O-ring. A split, tapered sleeve holds the tubing in place when a clamping nut is tightened. High wrench torque is not required because the seal doesn't depend on the tightness of the



nut (it fits loosely on the tubing). At low pressures, the natural resilience of the O-ring is said to effect a tight seal, and at high pressures the resulting distortion of the cross-section reportedly makes the seal even tighter. The fluid being handled provides necessary lubrication. Cutting tubes to an exact length is not required, and it is said that tube wall thickness need not be taken into consideration because the O-ring closure is on the outside diameter. Fittings are available in many shapes in tube sizes from  $\frac{1}{8}$  to 2 inches OD. *Lenz Company*, 3301 Klepinger Road, Dayton 1, Ohio.

**FOUR-WAY** solenoid-actuated valves manufactured by A. Schrader's Sons, a division of Scovill Manufacturing Company, Inc., make it possible to supply full line pressures to cylinders from a remote position. Available with single or double action, with or without a sub-base, each can be used for continuous or intermittent duty. According to the company, they are ideal for operating double-acting cylinders, keeping one side under air pressure until actuation exhausts the air pressure from the original side and then applying it to the opposite side, thereby reversing the cylinder piston action. Units are available, for 110-, 220- or 440-v a-c current in  $\frac{1}{4}$ -,  $\frac{3}{8}$ -,

$\frac{1}{2}$ - and  $\frac{3}{4}$ -N.P.T. (National Pipe Thread) sizes. Of poppet design, each has convenient mounting holes, and oil-resistant rubber washers for positive leakproof seals. All parts are designed for simplicity of replacement and interchangeability, and rust resistant stainless steel springs are utilized to give the



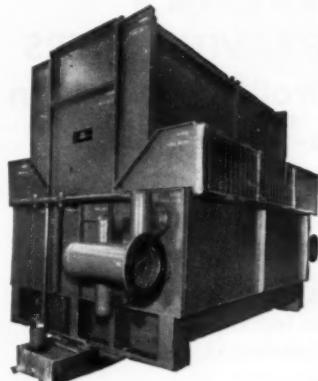
valves a long service life. *G. M. Basford Company*, 60 East Forty-second Street, New York 17, N. Y.

**P**ORTABILITY has always been one of the features of Fischbein bag closers, a fact that has not been eliminated from recently developed pneumatic models. The earlier machines utilize 110-v motors for use on a-c lines, and 220-v drives for d-c service. The air-operated models substitute Ingersoll-Rand Company's Size 00B1L air drills for the driving

## ECONOMICAL COOLING OF GASES AND COMPRESSED AIR

Cooling gases or cooling and removing moisture from compressed air, the Niagara Aero After Cooler offers the most economical and trustworthy method. Cooling by evaporation in a closed system, it brings the gas or compressed air to a point below the ambient temperature, effectively preventing further condensation of moisture in the air lines. It is a self-contained system, independent of any large cooling water supply, solving the problems of water supply and disposal.

Cooling-water savings and power-cost savings in operation return your



equipment costs in less than two years. New sectional design reduces the first cost, saves you much money in freight, installation labor and upkeep. Niagara Aero After Cooler systems have proven most successful in large plant power and process installations and in air and gas liquefaction applications.

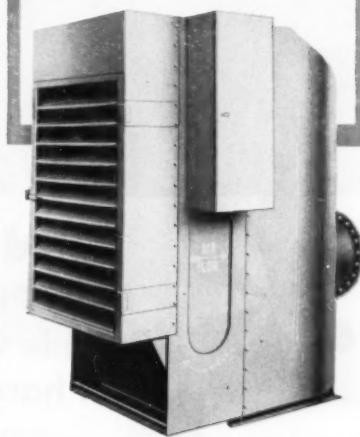
*Write for Descriptive Bulletin 130.*

## NIAGARA BLOWER COMPANY

Dept. CA-6, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

**AAF**  
**Multi-Duty**  
**Filters**  
**Assure**  
**Clean Intake**  
**Air**  
**Automatically**



Type CMS Multi-Duty for air volumes of 3000 CFM and up.

When your engines and compressors are protected by AAF Multi-Duty Self-Cleaning Filters, you know that intake air is clean.

Uniform air delivery, constant efficiency, low operating resistance and infrequent maintenance are "musts" for true dust protection. Multi-Duty measures up on every count because this filter keeps itself "fit" through continuous self-cleaning action.

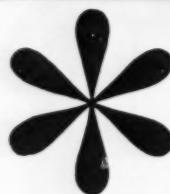
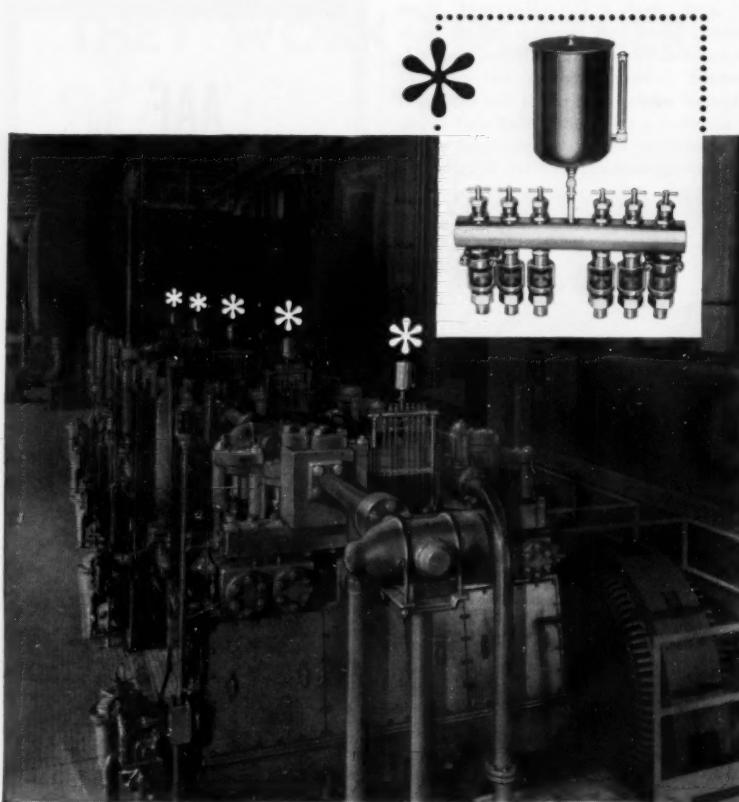
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## American Air Filter

COMPANY, INC.

402 Central Avenue, Louisville 8, Kentucky  
American Air Filter of Canada, Ltd., Montreal, P. Q.



## NUGENT

### MULTIPLE GRAVITY OILERS

#### Provide Controlled Lubrication for hard-to-reach bearings

The five Worthington Power Pumps shown above supply hydraulic power for a central hydraulic accumulator system in a large aluminum mill.

Each pump is equipped with a Nugent Multiple Gravity Oiler. The feeds may be individually controlled to deliver lubrication in predetermined quantities to otherwise inaccessible bearings.

Nugent Multiple Gravity Oilers are available with 2 to 23 feeds. Pressure Sight Flow Lubricators are also part of a full line of Nugent lubricating specialties. Before you decide on any filtration or lubrication equipment... see what Nugent has to offer.



REPRESENTATIVES IN  
PRINCIPAL CITIES

**WM. W. NUGENT & CO., INC.**  
3434 CLEVELAND STREET, SKOKIE, ILLINOIS

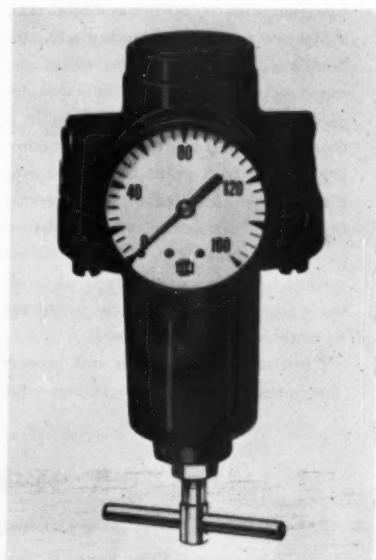
OIL FILTERS • STRAINERS • TELESCOPIC OILERS  
OILING AND FILTERING SYSTEMS • OILING DEVICES  
SIGHT FEED VALVES • FLOW INDICATORS



power, thus making the stitchers valuable for use in fire-hazardous areas, abrasive, or wet atmospheres, such as would be found in chemical and powder plants. Since the entire bag closer, designated as Model CR, including a full cone of thread, weighs but 9½ pounds, it can be operated with one hand, leaving the other free to grasp and guide the bag. A light touch on the starting button is all that is necessary to begin work. Stitches, with tightness and uniformity of length, are then put through almost any type of bag, whether it be textile, paper or a specially treated variety.

*Dave Fischbein Company, 2720 Thirtieth Avenue South, Minneapolis 6, Minn.*

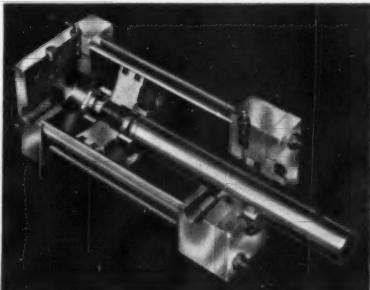
AIR-LINE pressure reportedly can be controlled at any desired working point with a regulator designed to provide sensitive and accurate control. The regulator is said to maintain a constant, uniform pressure while simultaneously preventing surge damage. The manufacturer states a large valve port gives great capacity and accurate handling, and provides a delivery range of 5- to



125-psig pressure. The entire valve assembly may be removed by hand for cleaning without the use of tools, and the unit is self-bleeding, allowing, it is said, instant pressure adjustment.

*Gits Brothers Manufacturing Company, Pneumatics Division, 1866 Kilbourn Avenue, Chicago 23, Ill.*

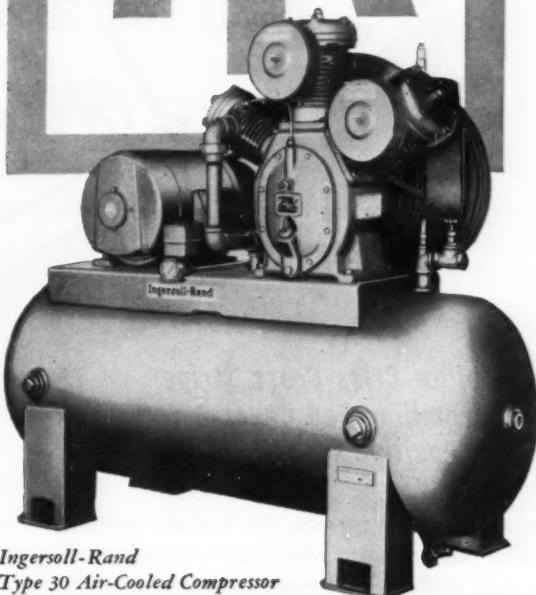
**S**QUAREMASTER is a line of 23 different models of air cylinders, each in ten bore diameters, recommended for a maximum air pressure of 150 psig and a maximum oil pressure of 500 psig. Designed with a safety factor of five, the units' honed brass tubing reportedly minimizes wear. Bronze floating-cushion bushings are said to provide smooth operation, while replaceable cartridge piston-rod bearings contribute to long



service life. The cylinders are available in seven standard mountings: extended tie rod; angle foot; lug foot; trunnion; blind end flange; rod end flange; and clevis. Adjustable cushioning can be provided to minimize the shock of the fast-acting piston against cylinder covers. The cylinders can be specially fitted for water service. *Rivett, Inc., Brighton 35, Boston, Mass.*

**P**ERSONS who wish to make remote readings of isolated meters, or batteries of meters where several readings are desired, will be interested in a "memory meter." The unit is a panel with a rear-mounted solenoid that is normally energized with its plunger retracted. When a reading is wanted, the solenoid is deenergized, causing its plunger to push against a face plate to stop a pointer. The device can be used at any point on its scale, not necessarily at the maximum reached by the signal. If desired, operation of the solenoid can be reversed so that it must be energized to permit the pointer's free movement. The meter, which is said to replace complicated electronic equipment, is available in a wide sensitivity range for either d-c or a-c current. It is built with a 4 1/2-inch rectangular plastic case, and in present models, the solenoid operates on 100 v d-c. *Assembly Products, Inc., Chesterland, Ohio.*

**eliminate  
costly  
down time**



*Ingersoll-Rand  
Type 30 Air-Cooled Compressor*

Ingersoll-Rand Type 30 air-cooled, air compressors have shown, time and again, that you can install and forget them except for periodic checks. Rugged construction and special design features give these compressors outstanding durability that never lets you down. Exclusive features pioneered by Ingersoll-Rand and proven through years of performance add economical operation — more air per horsepower.

I-R Type 30 Compressors are available from 1/2 through 20 hp; bare, baseplate or receiver mounted. Write for detailed information.

**Ingersoll-Rand**  
11 Broadway, New York 4, N. Y.

3-804

**Industrial Books  
and Literature**

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"Subway"® specifications include tough, oilproof black rubber tube; highest quality wrapped duck carcass; and a red rubber cover that offers long-lasting resistance to the effects of severe abrasive wear and all conditions of weather. Now furnished with yellow criss-cross stripe on cover for easier, more positive identification. Made in sizes  $\frac{1}{2}$ " to  $1\frac{1}{4}$ ", I. D., in lengths up to 50 feet. Contact our nearest branch for details and prices.

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HOSE • BELTING • FOOTWEAR • CLOTHING  
AND OTHER INDUSTRIAL RUBBER PRODUCTS

**GOODALL Rubber Company**

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BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES.  
IN CANADA: GOODALL RUBBER CO. OF CANADA LTD., TORONTO.

VERTICAL marine boiler-feed pumps, of the class VHTM, are the subject of Ingersoll-Rand's flier, Form 7492. These multi-stage units are available in capacities ranging from 100 to 600 gpm and discharge pressures of as much as 1500 psig. They can be driven by steam turbines or electric motors, and their multi-stage, heavy-duty design is said to provide low velocities and maximum service life. Because of their vertical design, the pumps require little deck space, and pump stages may be added or removed to suit the application; a unit-type rotor assembly permits withdrawal of the shaft, impeller and channel rings as a single unit. A cross-sectional illustration and a comprehensive page of data are included. *Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.*

THREE power test codes have been published by the American Society of Mechanical Engineers explaining fuels for diesel engines and heat generation, deaerators and water-cooling equipment. *Test Code for Diesel and Burner Fuels* contains methods for the collection of samples, and the determination of properties of liquid fuels used to generate heat or power. Gasoline or other fuels used in spark ignition engines are not included, however. *Power Test Code for Deaerators* was compiled because of failures in achieving plant operating savings and halting corrosion by including the deaerating section in the main condenser. A departure from the usual test code design is made in the *Power Test Code for Atmospheric Water-Cooling Equipment*. While other standards give a theoretical justification of methods recommended, this code is designed to guide the field engineer testing the equipment. Costs: Diesel and Burner Fuels, \$4.00; Deaerator Code, \$3.00; Atmospheric Water-Cooling Equipment Code, \$2.75. *American Society of Mechanical Engineers, 29 West Thirty-ninth Street, New York 18, N. Y.*

A HANDBOOK detailing all the major phases of plant engineering activity has been published by F. W. Dodge Corporation. This 704-page book consists of material gathered and prepared by the editors of *Plant Engineering* magazine and is called *Plant Engineering Practice*. Its purpose is to offer tested solutions to many daily problems. Reportedly, more than 100 experts in related fields contributed to this volume of 226 detailed studies. These are organized in thirteen sections: Sites and Layout; Construction; Housekeeping and Safety;

Materials Handling; Maintenance; Paints and Protective Coatings; Mechanical Power and Piping Systems; Electric Power; Lighting; Utilities; Heating, Ventilating and Air Conditioning; Instrumentation and Quality Control; and Shopwork. About 4 years of editorial research were required to complete the work, the editors weighing all material for its authoritativeness and comprehensiveness. Cost, \$18.50. *F. W. Dodge Corporation*, 119 West Fortieth Street, New York 18, N. Y.

COUPLINGS for guided-missile and aircraft applications are included in a 26-page catalogue describing quick-connect/quick-disconnect Snap-Tite units. Most feature remote disconnection with solenoid or lanyard action, although emergency manual removal is available. Smooth inside passages are designed to handle gases, hydraulic fuels, oxidizers, jet and turbine aircraft fuels and synthetic oils. Valves on both couplers and nipples shut off with no leakage when disconnected, trapping a minimum of air. The units have been designed to function through a wide variety of temperatures, ranging from minus 300° to plus 400°F, and operating pressures varying from 575 to 3300 psig. The couplings are fabricated from aluminum and steel alloys, and stainless steels. *Snap-Tite, Inc.*, Union City, Pa.

HYDRAULIC PACKINGS of the vee type, made of fabricated rubber and designed for industrial applications, are described in a 4-page folder that lists the number of leather, homogeneous rubber and fabricated rubber vee's which should be used under various operating pressures. It outlines the use of male and female adapters with vee sets. A complete listing of all Houghton standard sizes is included. *E. F. Houghton & Company*, 303 West Lehigh Avenue, Philadelphia 33, Pa.

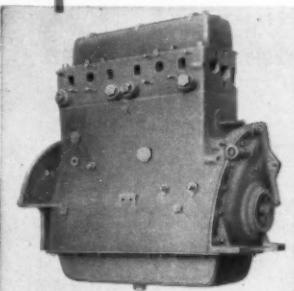


"I think we'd do more selling if you stuck them in your salesmen!"

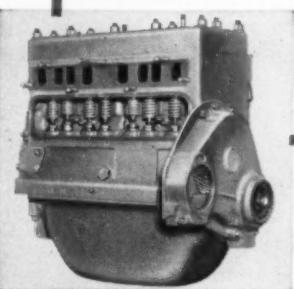
# CONTINENTAL "S" Assemblies Save Money in the CONSTRUCTION INDUSTRY

Good news for every user of construction equipment with Continental power! All models in the Continental line of industrial engines are now available in "S" Assembly form—basic engine unit complete with cylinder-and-block assembly, oil pan, cylinder head, piston and valve assemblies, crankshaft, camshaft, gear cover, bearings and caps, crank and cam gears and front end plate, fully assembled and torqued to specifications.

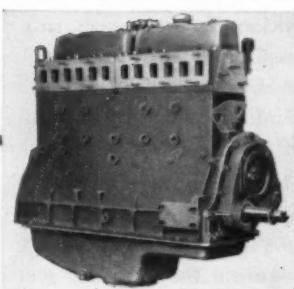
"S" Assemblies usually cost less than full overhaul, and they install in a fraction of overhaul time. And since the "S" Assembly embodies the latest results of Continental's continuing research, as regards both materials and design, it enables you to keep the very latest model on the job at all times.



DIESEL



L-HEAD



OVERHEAD VALVE

ASK YOUR EQUIPMENT DEALER ABOUT "S" ASSEMBLIES  
OR WRITE THE FACTORY FOR INFORMATION

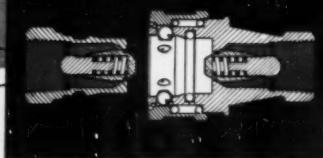


***Continental Motors Corporation***

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6 EAST 45TH ST., NEW YORK 17, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 50, CALIF.  
6210 CEDAR SPRINGS ROAD, DALLAS 8, TEXAS • 1252 OAKLEIGH DR., EAST POINT (ATLANTA) GA.

shuts off both sides of line...  
prevents loss of liquid,  
gas, or pressure.



Wherever  
2-way shut-off  
is required...

# HANSEN

QUICK-CONNECTIVE  
TWO-WAY SHUT-OFF COUPLINGS



WRITE FOR THE  
HANSEN CATALOG

To connect a Hansen Two-Way Shut-Off Coupling, you merely pull back the sleeve and push the Plug into the Socket. To disconnect, just pull back the sleeve. No tools required. When Coupling is disconnected, similar valves in Socket and Plug shut off both ends of line—practically eliminate spilling of liquid or escape of gas at instant of disconnection.

Hansen Series HK Two-Way Shut-Off Couplings are available with female pipe thread connections from  $\frac{1}{8}$ " to 1" inclusive. Available in brass or steel. Sizes generally required for L-P Gas service have approval of Underwriters' Laboratories.

Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight Through Couplings—including Special Service Couplings for Steam, Oxygen, Acetylene, etc.



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IN PRINCIPAL CITIES

SINCE 1915



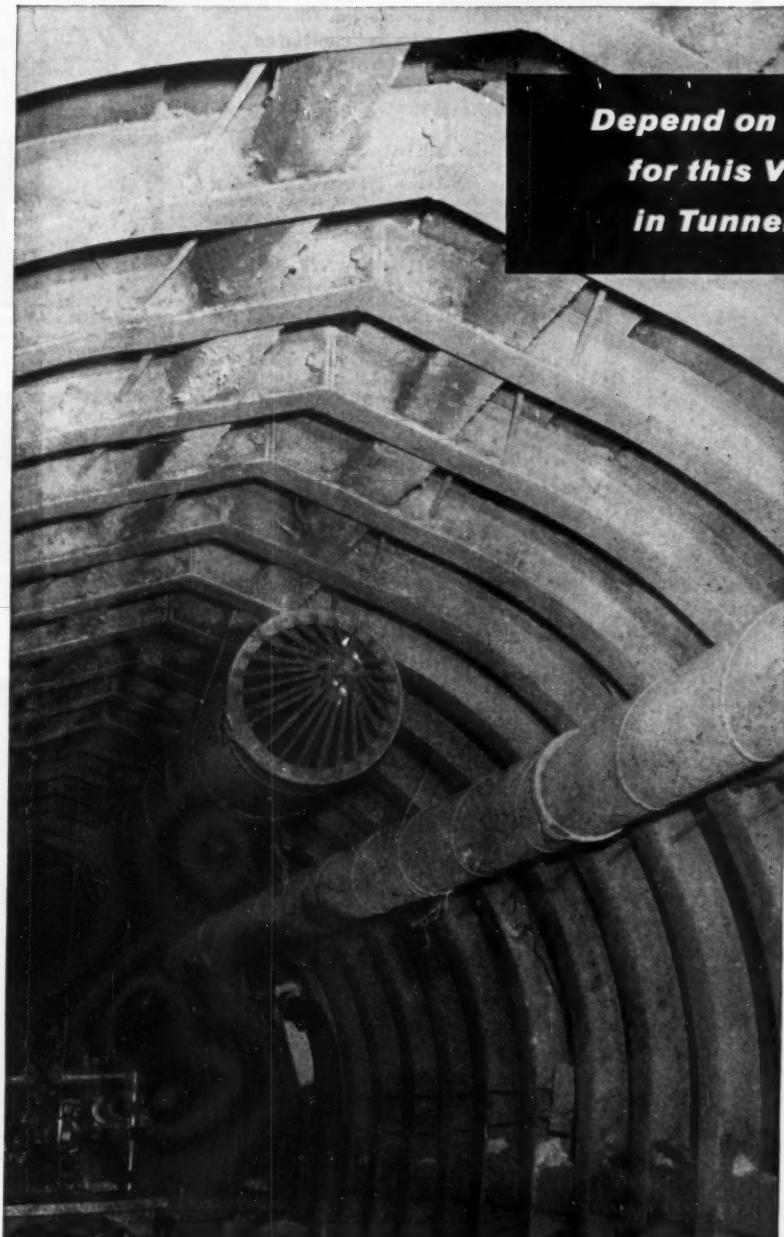
THE HANSEN

MANUFACTURING COMPANY

4031 WEST 150th STREET

CLEVELAND 35, OHIO

# For DEEP-DOWN Breathing...



**Depend on NAYLOR PIPE**  
*for this Vital Ingredient  
in Tunnel Construction*

There's nothing more precious than an uninterrupted supply of fresh air for underground operations. And there's no better way to get it there than through dependable, economical NAYLOR Spiralweld pipe.

Consider the advantages this distinctive pipe offers you. It's light in weight. Easier to handle and install—especially when you use the one-piece NAYLOR Wedgelock coupling to speed connections. Lines hug the wall—can be extended with only one side of the pipe in the open. And you can count on greater collapse strength and safety, because of its exclusive spiral-lockseam structure.

Anyway you look at it, you'll be time and money ahead to specify NAYLOR Pipe—not only for ventilating but also for other construction needs such as water lines, high air lines, dredging and other services.

**Write for Bulletin No. 507.**

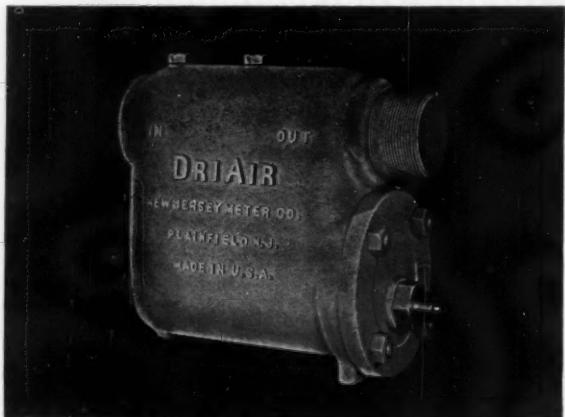


# NAYLOR

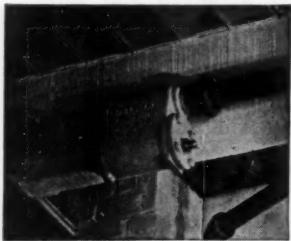
1245 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office  
60 East 42nd Street, New York 17, N. Y.

# DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY  
**DRIAIR**  
 A COMPLETE SELF-CONTAINED UNIT



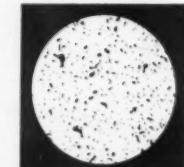
DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

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 METER COMPANY  
 PLAINFIELD, NEW JERSEY

## PROOF OF PERFORMANCE...

BEARIUM METAL is superior to any other bearing material. This statement can be substantiated by "proof of performance" reports from scores of satisfied users.



BEARIUM METAL magnified 25 diameters shows lead (black) in microscopic, globular form, uniformly distributed.



ORDINARY LEADED BRONZE at 25 diameters shows poor lead distribution, with lead between copper grains.

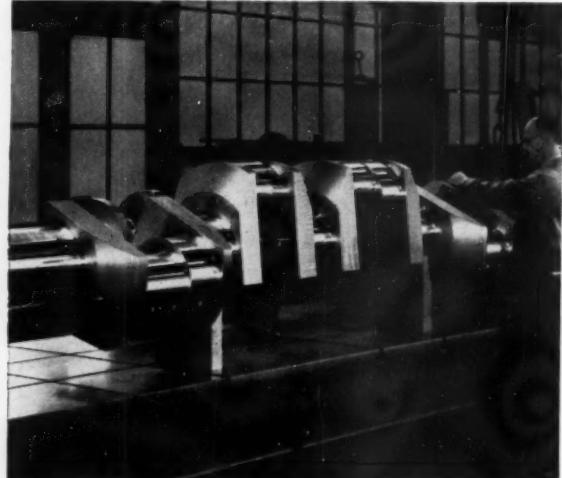
FEATURES: Non-Seizing and Non-Scoring. Long-Wearing • Self-Lubricating • Low Coefficient of Friction • High Compressive Strength • Resistant to Shock Loads • Sound, Uniform Structure • Free-Cutting.

Complete Information on Request.

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 THE TOUGH CRANKSHAFTS ?  
 .... and machines them, too



**NATIONAL  
 FORGE** & ORDNANCE  
 COMPANY

IRVINE, WARREN COUNTY, PA.

# The Right EXPLOSIVES

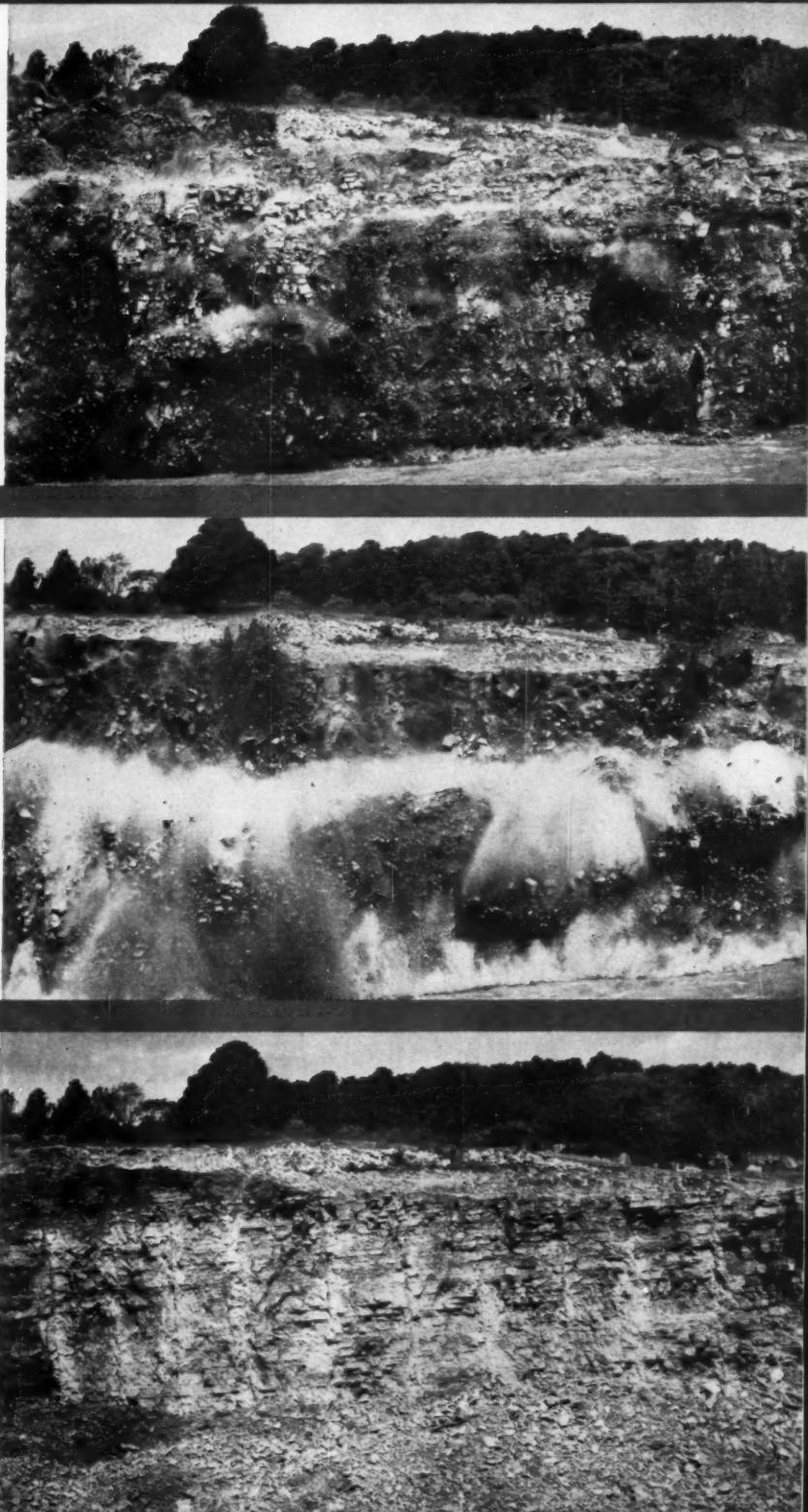
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**KNOW-HOW**

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**PAY OFF**

Hercules® Dynamite and Electric Blasting Caps, plus experienced "know-how," made possible these excellent blasting results in a traprock quarry.



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Hercules sales-engineers will be glad to assist in selecting the right combination of explosives and blasting methods to meet your particular requirements.

**HERCULES POWDER COMPANY**

INCORPORATED

Explosives Department, Wilmington 99, Delaware



**I-R DUAL-DRILL RIG** — Mounted on a sturdy steel frame suspended from the tractor boom, this dual rig drills two accurately-spaced holes at a time. Powerful drifter-type drills with air-powered feed and retraction make short work of pipe-line drilling. Single manifold connection, built-in air line lubricators and simple, centralized controls are designed specifically for this type of work.

**600-CFM GYRO-FLO COMPRESSOR** — Hooked-up behind the boom cat, this husky rotary unit provides a completely self-contained air power plant with ample capacity for operating the two heavy-duty drills. It can go anywhere, and stands up under the most severe temperature and climatic conditions.

## This I-R Combination pays off on FOUR CORNERS PIPE LINE

When A. P. Vaughn Contractors started work on Section 1 of the Four Corners Pipe Line—a 76 mile spread of 16-inch line from Aneth Field in Southern Utah to Kayenta, Arizona—they knew the going would be rough on men and equipment. The area is hot, dry and dusty. And operations would be carried on more than 100 miles from the nearest field office. Drilling equipment would have to stand up, day after day under a boiling sun and hot, wind-blown sand.

So they assigned their top teams to the job—Ingersoll-Rand Gyro-Flo portable compressors and PLM Dual Drill Rigs. With this equipment drilling 4-foot holes, two at a time, the line has been advanced at the rate of about a mile a day.

Whenever dependability and performance are vital, this I-R pipeline combination means maximum economy and minimum down-time for maintenance. For further details, get in touch with your Ingersoll-Rand representative today.

**Ingersoll-Rand**  
11 Broadway, New York 4, N.Y.



**AN UNBEATABLE COMBINATION...GYRO-FLO COMPRESSORS AND I-R ROCK DRILLS**

# Moisture and impurities form in cross-shop piping



## PROTECT your equipment with *Fulflo Filters*

No matter how pure your air at its intake source, moisture and rust are bound to form during cross-shop piping. Keep them from reaching your air-operated equipment with compact Fulflo Filters at every point of use. You make substantial savings through longer equipment life, trouble-free operation and low-cost maintenance.

Fulflo Filters minimize troublesome gumming by removing moisture, oil, microscopic rust,

dust, scale and dirt. Low-cost Honeycomb Filter Tubes last for many months under normal operating conditions. Tubes are easy to replace — simply by loosening a single nut. Multiple-tube models are available for high flow rates or central installations.

Find out how economically Fulflo Filters fit into your installations. Write for new catalog to Department CA.



**COMMERCIAL FILTERS CORPORATION**  
MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST



with genuine Honeycomb Filter  
Tubes for controlled micro-  
clarification of industrial fluids.



Selective filtration of oils • water-oil  
separators • magnetic separators •  
pre-coat filters • coolant clarifiers •  
automatic tubular conveyors.



This 110-B shovel digs and loads out 4,500 yards of copper ore and overburden every 8-hour shift in a western copper mining operation.

## Get INSTANT EXTRA TORQUE to meet every load

Pace-setting Bucyrus-Erie mining shovels give you an electrical control system that speeds acceleration and deceleration on every move, gives instant, extra torque to meet the load, speeds every work cycle.

It's the Bucyrus-Erie improved Ward Leonard variable-voltage control system—job-proved and famous for outstanding results in major open pit mines all over the world.

Your operator commands every operation

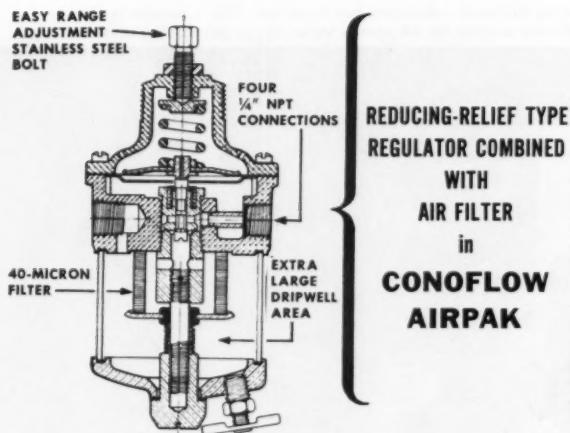
with well-grouped, simple controls for exceptionally smooth digging, swinging, hoisting, and propelling action. When you want speed . . . or torque . . . you GET it!

The result is more pit output at lower cost. Less mechanical and electrical maintenance, too. Write today for the complete story of these big Bucyrus-Erie electric mining shovels—4½-yd. 110-B, 6-yd. 150-B, 8-yd. 190-B. Bucyrus-Erie Company, South Milwaukee, Wisconsin.

19158

**BUCYRUS  
ERIE**

**MODERNIZE to economize!**



Insures a dependable source of filtered, regulated air for use with pneumatic controllers and other equipment. Provides highly accurate pressure regulation, regardless of wide variations in flow and upstream pressures. Made of chemically treated corrosion-resistant aluminum and stainless steel. Filter medium quickly cleaned by loosening only one bolt. Your best buy for easy installation and maintenance, rugged service, long life. Available in a variety of ranges and dripwell capacities.

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CC715

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SUBSIDIARY OF WALWORTH COMPANY  
2100 ARCH STREET • PHILADELPHIA 3, PA.

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what you're looking for . . .



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IT!**

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**T. B. WOOD'S SONS COMPANY**

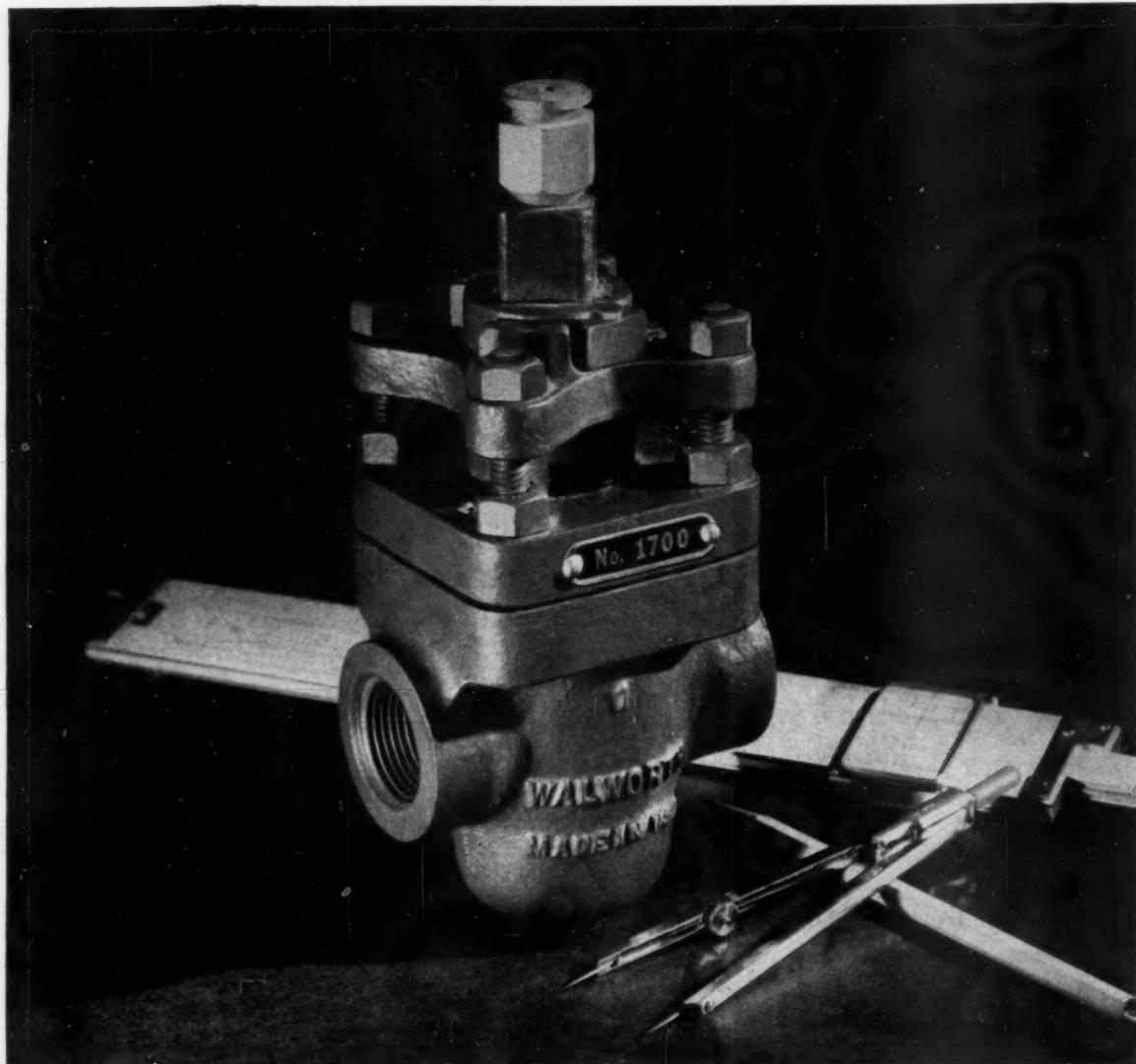
CHAMBERSBURG, PENNSYLVANIA

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Illustrated here is the Walworth Lubricated Plug Valve No. 1700, available in sizes from  $\frac{1}{2}$ " to 5" inclusive, suitable for 200 pounds water, oil, or gas working pressure.



*problem-solvers for tough jobs*

## \***LPV's by WALWORTH**

If you're familiar with the basic advantages of Plug Valves, you know why Walworth Lubricated Plug Valves work so well in really tough spots. You know about their direct port opening . . . their dead tight shut off. Seating and sealing surfaces are fully protected from attack by fluids being handled by insoluble lubricants.

\*Lubricated Plug Valves

Remember, you can get Walworth LPV's in all sizes . . . from  $\frac{1}{2}$  to 30 inches . . . for pressures up to 5000 psi and for vacuum service . . . in a number of different styles and patterns. For more information about LPV's and for your copy of the new Walworth LPV Circular, see your local Walworth Distributor.

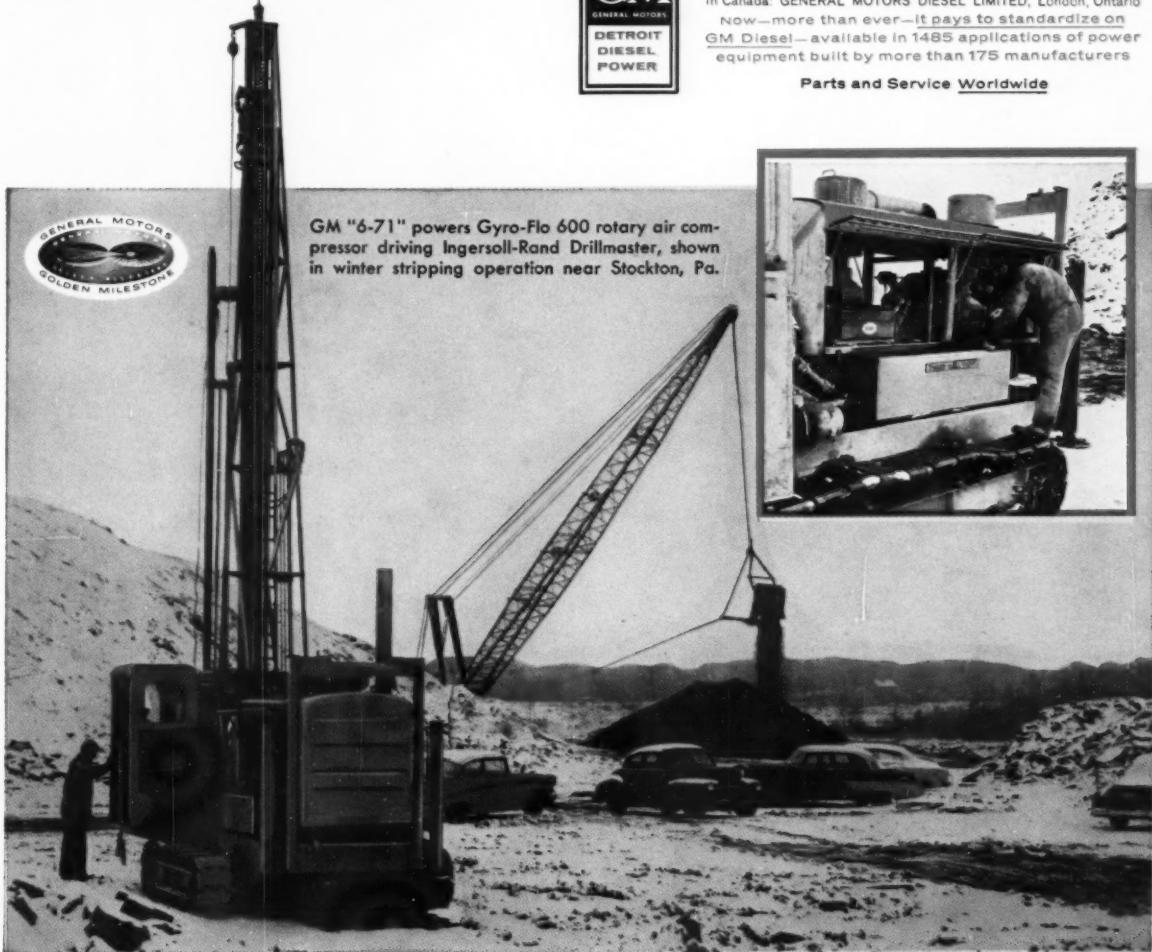
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GM "6-71" powers Gyro-Flo 600 rotary air compressor driving Ingersoll-Rand Drillmaster, shown in winter stripping operation near Stockton, Pa.

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